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RESEARCH ON VECTOR CONTROL

Malaria, filariasis and several viral infections are some of the diseases transmitted by mosquitoes and the control of these is of prime importance. For over two decades, vector control programmes have relied largely upon organochlorine and organophosphate insecticides. This is now threatened by the increasing resistance of vector species to available insecticides, the scarcity of new alternative insecticides, the increased cost of the major chemical insecticides which are petroleum derivatives and the hazard of environmental pollution that the use of some of these compounds produce. To test the feasibility of genetic control techniques in controlling or eradicating mosquito population, several field trials were conducted, using chemosterilized male releases, on *Culex fatigans* populations in Delhi villages in 1970. Even though high degrees of sterility in the mosquito population could be achieved, mosquito control was not possible mainly on account of the biological factors viz. extensive breeding, widespread migration and high reproductive potential. The experiments showed that it may not be possible to control *C. fatigans* by genetic methods alone in the environmental conditions existing in India where they are not found as isolated populations. Genetic control methods for *Anopheles stephensi* are not available due to several reasons, viz. (a) suitable methodology to study the species is not available, (b) mass rearing of the species and its sexing have not yet been achieved, and (c) there is no genetic system, at present, which can be put into operational use.

In view of the immediate and long term needs of the country, a centre for Vector Control Research was established at Pondicherry in 1975. The objectives of the Centre are to carry out research on all methods of control of arthropods of public health importance, which include insecticidal, biological (including genetic and microbial) and environmental control and also to study certain hitherto unknown aspects in the epidemiology of the two important mosquito-borne diseases viz. malaria and filariasis. The results of some of these studies are highlighted below:

VECTOR ECOLOGY:

Of the three major vectors of malaria in south India *Anopheles culicifacies*, *Anopheles fluviatilis* and *Anopheles stephensi*, the latter appears to be present in very small numbers in Pondicherry. *A. stephensi* was found to be breeding in 11.8 per cent to 46.6 per cent of the wells in the town. Regular fortnightly surveys of the wells showed that the average number of pupae per well was low (0 to 1.20 in different fortnights) indicating that emergence of adults from wells is low. This was confirmed by trapping newly emerged adults in emergence traps placed over the wells. However, since trap efficiency was demonstrated to be low, the actual emergence from wells may be somewhat higher than what the results indicated.

Intensive efforts to develop a methodology for the capture of adult *A. stephensi* were generally unsuccessful, probably due to

the low population density of this species in Pondicherry. All night collections on human bait and in cattle sheds were made on 8 occasions in five different localities where *A. stephensi* was found breeding. Out of about 4500 *Anopheles* collected, 37 were *A. stephensi*; one taken on human bait and the rest in cattle sheds.

BIOLOGICAL CONTROL:

The concept of biologically controlling obnoxious pests of public health importance is fairly recent. Many methods of biological control of mosquitoes have been advocated and barring the use of predatory fishes, the other methods are still in the experimental stage.

Fishes:

Use of fish for mosquito control has been in operation in many countries and notable success in malaria control by this means has been claimed in many countries, chiefly Iran, Soviet Union and U.S.A. In Iran, fish has been successfully used as an auxiliary measure along with other control measures like use of insecticides; similar success has been achieved in an experimental pilot study in India at Hyderabad.

As a result of intensive survey for indigenous larvicidal fishes in different habitats in the Pondicherry area, 13 species have so far been recognised and maintained in the laboratory. In addition, the Guppy, *Poecilia* sp., has been brought from Madras. The Guppy (like *Gambusia* and *Tilapia*) though an exotic species, was introduced in India many decades ago and is now found in several parts of India.

The predation efficiency of the different species of fishes was tested in the laboratory and showed a range of 10-110 mosquito larvae per day per fish. The largest consumers of larvae were *T. mossambica* (110), *Ophiocephalus* sp. (80), *G. affinis* (66), and the Guppy, *Poecilia* sp. (54). The former two species are predators in both the juvenile and adult stages. Their utility in large scale control measures is limited. Very little is known about the biology of the other indigenous species and these are now being studied to explore the possibility of mass rearing them.

Salinity tolerance of *O. melastigma*, *A. blochii* and *G. affinis* was tested against ambient saline solution and the results show that *O. melastigma* and *A. blochii* have

greater tolerance for salinity than *G. affinis*. But in the environment where mosquito breeding takes place, *G. affinis* with further selection can be expected to survive better.

In order to select a species of fish for practical application in mosquito control, the candidate fish must have the following properties:- (i) it should be a live-bearer which could be easily mass reared; (ii) it should be small in size and be able to penetrate easily most mosquito breeding habitats; (iii) it should feed preferentially on mosquito larvae and pupae, when they are available but should be a diverse feeder capable of surviving when the mosquito larvae are not available; and (iv) it should have good tolerance for variations in temperature, salinity and organic waste pollution and for a large number of chemical larvicides.

Whereas very little is known about the potential of the indigenous larvicidal fishes for practical application, *G. affinis* seems to have most of the requisite properties. However, its tolerance against organic pollution seems to be low. The Guppy (*Poecilia* sp.) has been known to tolerate organic pollution, and at the same time has all the other qualities of *Gambusia*.

In a small scale field trial in Pondicherry, 10 wells with mosquito breeding were selected and *O. melastigma* was introduced into seven wells. Fifty fishes were introduced in each well. In the wells where mosquito larval density was moderate (1,000 to 15,000), the wells turned completely negative in a week's time. In two wells with high mosquito larval density (150,000 to 500,000) while no absolute control was achieved, the density decreased after three weeks (130 to 300,000 respectively). In these wells thousands of egg rafts were found on each observation. It is possible that the number of fishes introduced in these wells may not have been adequate. In wells where no fishes were introduced, the mosquito larval density actually increased ten fold. Further studies are needed for conclusive results.

Work is now in progress on mass rearing of *G. affinis* and *Poecilia* sp. for field releases. Their tolerance to insecticides and other chemicals is also being investigated.

Insect predators:

Under natural conditions some species of

aquatic bugs belonging to the family *Notonectidae* suck the sap of mosquito larvae and kill them. Three species collected locally were identified as *Anisops bowieri*, *A. kempi* and *Enithares ciliata*. Predation studies in the laboratory showed that *A. bowieri* has the potential for being used as a biological control agent. It was observed during field surveys that habitats which contained these bugs in large numbers had either very few or no mosquito larvae. To demonstrate the predation efficiency of these bugs, two cisterns of identical measurements containing water were set up in the back yard of the laboratory. Two egg rafts of *C. fatigans* were seeded daily in both the cisterns. A small amount of larval food was also provided to reduce the mortality. After seven days twenty bugs were introduced into one of the cisterns and daily seeding of egg rafts continued. From the cistern with bugs only 1302 pupae were collected as against 3314 pupae from the cistern without bugs.

The experiment was repeated with the bugs being introduced on the day of seeding of egg rafts. A daily seeding of 10 egg rafts was made in each cistern, with ten bugs in one of them. The bugs were observed to attack the rafts and many eggs disintegrating from the rafts sank to the bottom. The predator action of the bugs was greater on the egg rafts than on the larvae. Although in an environment infested heavily with larvae, the bugs could reduce the population of larvae, their importance lies in the prevention of hatching of egg rafts.

During the 25 days of observation 2853 pupae were recovered from the cistern which had no bugs, whereas not a single pupa was produced in the cistern which had bugs, inspite of a daily seeding of 10 egg rafts. Laboratory studies on the biology of the bugs showed that their life cycle extends for about 35 days and that each of the five stages of nymphs predate on mosquito larvae. Further studies on the biology of this species, in an attempt to mass rear them, are in progress.

Larvae of *Culex (Lutzia)* sp. predate on mosquito larvae in nature and are one of the chief factors responsible for their mortality in certain habitats. Attempts are being made to colonize the predator species from wild collected larvae and pupae. Simultaneously, studies are also being conducted on the biology and predation efficiency of these species. Laboratory studies showed that one fourth instar larva of *Lutzia* has the capacity

to predate on 20-25 fourth instar larvae of *C. fatigans* in one day.

Microbial agents:

(i) Surveys:

A randomised sample survey has been undertaken in and around Pondicherry to determine the incidence of parasites and other pathogens in mosquito larvae. Paddy fields, ponds and ditches have been searched in four localities so far. In three of these, mosquito larvae infected with a fungus resembling *Coelomomyces* sp. have been found and others infected with nematodes (probably mermithids) have been found in all the four localities. In paddy fields, both *Anopheles* (*A. Subpictus* and *A. vagus*) and *Culex* (*C. vishnui*) larvae have been found infected with fungus. A high proportion of the larvae examined were infected with fungus (246 out of 627 *Anopheles* larvae and 62 out of 181 *Culex* larvae). *Anopheles* larvae infected with nematodes have also been found in ditches and in a cement tank. 6 of 68 *Anopheles* larvae, (probably *A. stephensi*) from urban wells were infected with fungus.

In certain paddy fields, the infection seems to be heavy. Mosquito larvae collected from such localities show infection as high as 50 per cent for fungus and 80 per cent for nematodes.

(ii) Microbial agents from mosquito larvae:

Fungus infected mosquito larvae were easily detected in nature by their characteristic rusty appearance and were found to be full of sporangia in different stages of maturation and in some instances the mycelium could be observed. In the laboratory, the infected larvae generally died before pupation, indicating that the fungus was lethal. However, one of the several adult mosquitoes examined in the laboratory showed sporangia indicating that very rarely a few infected larvae do pupate and become adults. Germination of sporangia resulting in the liberation of zoospores was observed. This has been found to be one of the important methods of dissemination of the pathogens in nature. The infected larvae could be stored at 5°C on wet filter paper. Germination was observed in the stored specimens also. The stored materials were observed periodically to determine whether they remained viable under the conditions of storage. The size, shape and markings on the sporangia and the nature of

the mycelium of the fungus infecting *Anopheles* sp. and *Culex* sp. appear different suggesting that there are two different species of fungi. The nature of mycelium and the sporangium, the appearance of the infected host and the method of germination of the sporangium indicate that the fungus belongs to *Coelomomyces* sp. Studies are in progress to standardize the method for mass culturing of this fungus.

Mostly third and fourth instar mosquito larvae were found infested with nematodes. Generally one or two, and in rare instances four worms were found in the haemocoel. The infested larvae under laboratory conditions did not pupate and invariably died. The actual emergence of the nematode and the oozing out of the haemolymph were also observed. This has been reported to be the cause of death in nematode-infested larvae. Examination of naturally occurring pupae did not reveal the presence of the nematode.

The lack of pupation of the infested larvae and emergence of the nematode resulting in the death of the host would indicate that the nematode observed is a parasite probably belonging to mermethidae.

Two bacterial agents have been isolated from a sick *Anopheles* larva. Preliminary studies indicate that they are lethal to the mosquito larvae. Experiments are in progress to determine their pathogenicity to other species of mosquitoes.

MOSQUITO COLONIZATION:

Rearing:

Colonies of *C. fatigans* (Pondicherry and Delhi strains) and *A. stephensi* type maintained in the laboratory have the capacity for production of upto 10,000 larvae/day. The number can be increased if required.

Separation of male and female *A. stephensi*:

Since similar sizes of the pupae in *A. stephensi* larvae have handicapped the mechanical separation of males and females required in a release programme, strains with small sized male pupae and larger female pupae, have been obtained by a process of selection. This process is still continuing and is in the F₁₀ generation at Pondicherry. Alternatively, efforts are being made to select a line in which males pupate a few days before females. This selection process is in the second generation.

Colour variations in laboratory colonies of *C. fatigans* and *A. stephensi*:

Pink, green and brown larvae and pupae of *C. fatigans* and brown, green and black larvae and pupae of *A. stephensi* have been observed in normal rearing trays. By a process of selection, a green line of *C. fatigans* has been purified and is now in F₁₂ generation. Attempts are in progress to purify the other lines. In *A. stephensi*, heavy pupal mortality was observed consistently in the trays with green larvae. The brown and black strains have been isolated and further selection is in progress for purifying the strain. The selected purified strains, when ready, will be tested for differences in susceptibility for malaria transmission. Their biological characteristics are now under study.

Colonization of *A. culicifacies*:

It is well known that this important malaria vector species has not been colonized in the laboratory so far. Attempts are, therefore, being made to colonize *A. culicifacies*, the major malaria vector. Probably as a result of intensive spraying with insecticides as part of public health and agricultural measures, this species have become rare even in conventional breeding places like paddy fields. Extensive collections were made in pools in Penniar river in Pondicherry and South Arcot and it was found that less than 0.1 per cent of larvae were *A. culicifacies*. Attempts are continuing to locate more breeding places further upstream, where *A. culicifacies* breeding has been reported. About 70 specimens have been obtained so far and attempts are being made to overcome the difficulties experienced in mating and oviposition in the laboratory.

GENETIC STUDIES:

Radiosterilization:

Irradiation of *A. stephensi* with 7 kR from a cobalt 60 source induced 100 per cent sterility in the females and 96.5 per cent sterility in the males. Radiosterilised males competed favourably in the insemination of females. In order to achieve higher male sterility, pupae were irradiated with 8 kR. Sterility in males averaged 97.2 per cent with reduced competition for mating. Even at a dose of 10 kR, which is injurious to males, sterility averaged 99 per cent. Efforts are, therefore, being directed towards chemo-

sterilisation of *A. stephensi* to achieve 99.9 per cent male sterility.

Culex pipiens fatigans (Prague cytoplasm) is bidirectionally incompatible with majority type Delhi strain while with the minority Delhi type it is unidirectional i.e. females of Prague cytoplasmic type are compatible with minority (De 19) type males. The frequency of De 19 type males varies from one geographical area to another (Delhi 10-30 per cent, Arni 50 per cent, Trivandrum 70 per cent). At optimum efficiency, grids can separate males with 0.3 per cent female contaminants. These contaminant females may mate with De 19 males and establish a new strain in the area of release. Therefore, if the cytoplasmic incompatibility phenomenon is to be used for population control, female contaminants should either be removed or made non-reproductive. This can be achieved by radiosterilization of the release material at a dose that would make the contaminant females non-reproductive. Experimentally it was found that females fail to oviposit at 4000R, a dose which produces 50-60 per cent sterility in the males. Therefore, radiosterilization of the *C. fatigans* (Prague cytoplasmic) at 4000R would ensure elimination of all reproductive females and provide extra protection against the possibility of the loss of cytoplasmic incompatibility in males due to aging - a phenomenon recently observed.

Chemosterilization:

Use of thiotepa to sterilise mosquitoes as part of an eradication programme in India was criticised in view of the possibility that either thiotepa or its breakdown products may contaminate the food chain components. This was substantiated by a research report that spiders fed on mosquitoes sterilized with thiotepa had reduced fertility. Hence it became necessary to find a method that could eliminate residues of thiotepa from chemosterilised mosquitoes. This breakthrough was achieved by dipping the chemosterilized pupae in acidic water (pH 2.6-2.8) and then in alkaline water (pH 9.1-9.4) for 90 minutes each. Dipping of pupae in acidic water ensures breakdown of thiotepa to ethyleneimine while dipping in alkaline water leads to breakdown into non-toxic phosphoric acid compounds. Residue-free emergent mosquitoes survive well for at least 3 weeks and compete favourably with untreated males in the insemination of females. Mass release of such males for population control will not pose the hazards of environmental contamination.

Mating competitiveness and insemination capacity:

Mating competitiveness of small size sterile males was tested and compared with that of mixed size sterile or normal males and it was found that there was no significant difference in either the mating competitiveness or insemination capacity.

Genetics of *A. stephensi*:

Inversion polymorphism: Cytological analysis of polytene chromosomes from larval salivary glands from different geographical areas in and around Delhi, Bangalore and Coonoor have exhibited inversion polymorphism. Five different pericentric inversions in different arms of the autosomes have been observed. The frequency and type of inversions vary from stock to stock. There appears to be a correlation between egg hatch and the number of inversions present in any stock. This study has been undertaken to correlate the presence of a particular inversion to insecticide tolerance and vectorial susceptibility.

Translocations: One autosomal (R-26) and one male-linked translocation (R-56) have been induced in a laboratory colony of *A. stephensi*. R-26 translocation has an average sterility of 58.3 per cent while the R-56 translocation shows 70-80 per cent sterility. Cytological analysis of the R-56 translocation revealed that it involves all three chromosomes. Mating competitive tests have shown that R-56 males are equally competitive with wild males. High sterility, absence of crossing over and its mating competitiveness suggests that R-56 translocation has a potential value in genetic control.

Genetics of *Culex pipiens fatigans*:

Cytoplasmic incompatibility: Experiments have been designed to obtain direct evidence for rickettsial involvement in the phenomenon in cytoplasmic incompatibility. An equal number of larvae from aposymbiotic line (obtained by treating the larvae with tetracycline and is free of rickettsiae) and from De *ru/ru* (Delhi cytoplasmic and *ruby-eye* marker) were cultured together for several generations. If rickettsial organisms can pass from one organism to another it is possible that aposymbiotic larvae can get reinfected with rickettsiae from *ru/ru* larvae during larval development. Appropriate genetic crosses have shown that there is no change in the cytoplasmic proper-

ties of aposymbiotic line. Electron microscopic studies are in progress to see whether rickettsial organisms have reinfected the aposymbiotic line.

Male-linked translocations: Five male linked translocations are available. Three of the translocation lines are being maintained as selected and unselected lines with 70-80 per cent and 50-60 per cent sterility levels respectively. Cytological analysis of meiotic chromosomes from pupal tests has shown that both selected and unselected lines carry a single translocation involving sex chromosome and an autosome. This suggests that the difference in sterility level between selected and unselected lines is not due to the difference in the number of translocation complexes but it may be due to recessive lethals present in selected lines which are being carried from one generation to another because of the selection procedure. In addition, cytological analysis has confirmed the genetic studies carried out with the translocation lines using an autosomal marker in establishing which of the two autosomes is involved in each translocation. One translocation D 371 involves all three chromosomes and thus exhibits higher sterility (70-80 per cent) without any selection procedure.

Autosomal translocations: Eight autosomal translocations have been induced for various genetic studies. Females from three translocation lines were crossed with males from a male linked translocation to obtain double translocation heterozygotes involving all three chromosomes. Out of three such double translocation heterozygotes one line has shown 77.2 per cent sterility and this appears to offer a potential measure for genetic control programme. In addition, by crossing males and females from different translocation lines double translocation heterozygotes involving only two chromosomes were obtained but their sterility levels when crossed with wild type were much lower than the double translocation heterozygotes involving all three chromosomes. Autosomal translocation lines are cytologically being screened to select translocations with specific break points for use in the synthesis of compound chromosome.

Phenotypic markers: One larval colour mutant *green larva* has been isolated in a laboratory stock. Genetic studies have shown that it is a recessive gene and has been mapped on chromosome 3.

STUDIES ON FILARIASIS:

Considerable work on filariasis has been done in India during the last 25 years in an attempt to determine the extent of the problem and to control and prevent the disease. But, very little attention has been paid to the study of the parasite and the understanding of the disease process. It has been suggested that several thousand infective bites are necessary over a period of time to produce one new case with circulating microfilariae.

Infection and disease in filariasis are generally assumed to be a function of the intensity of the transmission in an area. Therefore, to characterise the dynamics of transmission, several field studies were undertaken in the Pondicherry area, with the active co-operation of the local health department.

Night blood surveys:

Blood samples collected from residents of 8 localities of Pondicherry were examined for microfilaria. Of a total of 795 blood samples collected, 157 (19.7 per cent) were positive for microfilariae, indicating that approximately every one person in five circulated microfilariae in his blood. The mean microfilaria density (number of microfilariae per 20 c.mm. of blood) in various localities ranged between 12.5 and 53.5, with an average of 27.4. The number of microfilariae per infected individual ranged from 1 to 359. Individuals of all ages and sex groups circulated microfilariae. Contrary to reports published so far, even old people (aged above 60 years) circulated high numbers (more than 100) of microfilariae. Only 18 people (2.25 per cent of the sample surveyed) had clinical manifestations like elephantiasis of the limbs. None of them had microfilariae in their blood. It is recognised that the data on filarial infection among the population obtained in night blood surveys may apply to entirely different phases of infection and may reflect the individual differences in response to infection. Studies have been undertaken to correlate, with the help of a questionnaire prepared for this purpose, the disease and infection rates on the one hand, to the habits, socioeconomic status, period of stay in known endemic area, etc. on the other.

Vector density:

Density of indoor resting *C. fatigans* females was routinely measured in 5 localities

of Pondicherry. The relative density (number per man hour) varied from one locality to another, but on the whole, it was high, (ranging from 25 to 61). Seasonal variation in the density was seen: in the monsoon months (July to November) it was comparatively lower than in the post-monsoon months (December to March). The mean maximum temperature ranged between 27°C and 33°C and the minimum between 19°C and 25°C. The relative humidity varied between 64 per cent and 85 per cent.

At fortnightly intervals all night collection of *C. fatigans* biting man was carried out. The biting intensity was highest between 11 p.m. and 4 a.m. The number of female *C. fatigans* biting a man in one night ranged between 154 (in the rainy months of November) and 454 (in the first fortnight of March).

Infection and infectivity rates in *C. fatigans* for *W. bancrofti*:

Because of the high rate of microfilaraemia in the population at Pondicherry, as revealed by the surveys (19.7 per cent) the infection rate and infectivity rates for filarial larvae in the vector population were routinely assessed. For this purpose, fed, semigravid and gravid mosquitoes of *C. fatigans* collected in houses were dissected. The infection rate (number of mosquitoes with all stages of filarial larvae/total number of mosquitoes dissected) ranged between 1 per cent to 13.5 per cent. The infectivity rate (number of mosquitoes with the infective stage of filarial larvae/total number of mosquitoes dissected) ranged between 0 per cent to 3.5 per cent. There were variations in the rates observed in different months and in different localities.

Experimental transmission studies:

The wild population of *C. fatigans* has been found to be a mixture of several types characterised by the colour of larvae e.g. black, green and brown. Apart from this species, the other major man-biting mosquitoes at night in this area are anophelines *C. tritaeniorhynchus*, and *Armigeres obturbans*. The green strain of *C. fatigans* has been purified and is now in the twelfth generation. Vectorial susceptibility studies were conducted with *A. stephensi*, *C. tritaeniorhynchus* and the green *C. fatigans* strain. Preliminary results show that while the green strain of *C. fatigans* is an excellent vector, both *A. stephensi* and *C. tritaeniorhynchus* are poor

ones. Laboratory bred *C. fatigans* and *C. tritaeniorhynchus* were fed on donors with a mean microfilariae count of 180/20 c.mm. While the infective stage of the larvae developed in *C. fatigans* on the 10th day and were found in the head from the 11th day onwards, in *C. tritaeniorhynchus*, the microfilariae did not develop beyond the first stage, and that too only in a few mosquitoes. In most of the mosquitoes, the microfilariae were found dead. In the case of *A. stephensi* also the microfilariae did not develop beyond the first stage in some mosquitoes and in one mosquito upto the second stage. No infective stages were found. There was also heavy mortality of *A. stephensi*. The experiments are being repeated.

Armigeres obturbans has been incriminated in the transmission of *Setaria digitata* for which bovines are the definitive hosts. A colony of this mosquito is being established for studying its susceptibility for *W. bancrofti*.

Studies have been initiated on the comparative susceptibility of normal and genetically manipulated strains of *Aedes aegypti* in *Dirofilaria* infection. Results of this study revealed that sterilisation of pupae and adults (before a blood meal) had no effect on the vectorial potential of the females. However, adult sterilisation after blood meal resulted in complete inhibition of the growth of parasites. Therefore, release of contaminated females may not be hazardous in terms of the vectorial potential.

Attempts to select a strain of *C. fatigans* refractive to periodic *W. bancrofti*:

It has been shown in the case of *Aedes aegypti* that genetic factors influence the susceptibility to infection with the filarial parasite, *Brugia malayi*. It has also been demonstrated with *W. bancrofti* that the susceptibility can either be increased or decreased by a process of selection. In the event of eradication of *C. fatigans* by genetic control or any other method, the ecological niche will have to be filled by another mosquito. Hence, the possibility of replacement of a vector strain by a non-vector strain has been suggested. Attempts are, therefore, being made to select a strain refractory to filaria transmission.

Initially four batches of mosquitoes were fed on donors with varying microfilaria density. Fed mosquitoes were individually tubed

for egg laying and further dissection. It was found that presence of microfilaria adversely affected the physiology and survival of mosquitoes. The normal time taken for development of infective stage of microfilaria is 11 to 14 days. If the mosquito laid its eggs before this period, it could be dissected and examined for the presence of microfilariae. But in most cases, even under controlled climatic conditions (temperature $28^{\circ}\text{C}\pm 1^{\circ}\text{C}$, relative humidity 80 to 85 per cent, the mosquitoes fed on donors did not lay eggs for as long as 38 days. However, in a few lines which were found negative their progeny were reared and fed on donors. In subsequent generations, because of inbreeding depression due to brother-sister matings, high larval mortality was observed. From the four batches of mosquitoes in the parental generation, 251 mosquitoes which had laid eggs were dissected and 28 negative lines were obtained and

pursued in the next generation. Many of the mosquitoes also laid unembryonated eggs. At present only 3 negative lines are available and they are in F_8 generation.

Apart from delayed egg laying and high larval mortality, the fecundity was also low. Experiments have been planned to overcome some of the problems caused by the effect of microfilariae on the mosquitoes. By feeding the lines once on chicken blood before feeding on the donor it is hoped to increase the fecundity and by pooling the negative lines of the same generation it is expected to overcome the problem of inbreeding depression caused by brother-sister matings. Attempts are also being made to select strains from localities with very low filaria endemicity and low or no infection and infectivity rates in mosquitoes.

ABSTRACTS

Some Research Projects completed in 1975

OCCUPATIONAL HEALTH:

A study of cardio-respiratory status of scissor makers at Meerut

A total of 175 scissor makers (100 grinders and 75 non-grinders) working in different scissor manufacturing units of Meerut, were studied for their cardio-respiratory status. None of the non-grinders had radiological evidence of silicosis whereas out of the 100 grinders, 55 showed pulmonary silicosis. Of the 55 grinders with silicosis, stage I (prenodular) changes were present in 3, Stage II (nodular) changes in 29 and stage III changes in 23 cases. Three of them had associated tuberculosis (silico-tuberculosis). Incidence of silicosis increased with the duration of exposure. A direct correlation was observed between the incidence of silicosis and time intensity factor i.e. dust count multiplied by number of years of exposure. All grinders with time intensity factor (T.I.F.) above 3000 had radiological evidence of silicosis. Further, stage III massive shadow or massive fibrosis silicosis was observed in the majority of grinders whose T.I.F. was above 2000. The average dust count in various scissor grinding units ranged from 26 to 193.6 million particles per cubic foot of air with a mean of 112 mpcf. The size of majority of particles was less than 5

microns and concentration of free silica ranged from 23 - 37 per cent with a mean of 31.8 per cent. Greater reduction of vital capacity was observed in grinders with stage III silicosis as compared to those showing stage I and stage II radiological changes. Twelve out of 55 grinders with silicosis showed evidence of right ventricular and/or right atrial hypertrophy, of whom 9 had stage III silicosis. No E.C.G. abnormality was detected in non-grinders and grinders with stage I silicosis.

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CARDIOVASCULAR DISEASES:

Effect of Bengal gram on acid mucopolysaccharide content of aorta

The data obtained from the study on 120 rabbits confirmed earlier observations that Bengal gram supplementation of the diet resulted in regression of egg-yolk induced experimental atherosclerosis in rabbits. This effect was similar to that produced by oestrogen injections and was observed in both male and female animals. The glycosaminoglycan (GAG) content of aortic tissue was found to be

increased in egg-yolk fed rabbits as the atherosclerotic process progressed, but in both Bengal gram supplemented and oestrogen treated groups GAG accumulation decreased. It is possible that the lipodiatic activity of Bengal gram was due to its isoflavone Biochemin A, which is similar to oestrogen in its molecular configuration.

Tissue lipid storage was also decreased in the groups treated with Bengal gram and oestrogen. Another interesting finding was the nodular lipid storage in the spleen seen in oestrogen treated female rabbits. These nodules became smaller and fewer 3 months after withdrawal of the oestrogen treatment. The exact relationship between oestrogen and the nodular lipid storage in the spleen was not clear.

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OPHTHALMOLOGY:

Therapeutic value of corneal grafting in chemical burns

Experimental studies were carried out on rabbits to evaluate the role of keratoplasty in alkali burns of the cornea. Both general and local corneal burns with varying degrees of severity, were produced.

When the damage to the cornea was general and superficial (Grade I), conservative therapy gave excellent results. When the damage resulted in a hazy cornea, but iris details were visible (Grade II), the eyes could be saved with medical or surgical measures. The best results were obtained with penetrating keratoplasty, specially when performed within 24 hours of the injury.

When the result of the damage was a hazy cornea and iris details were invisible (Grade III), medical therapy gave poor results. Surgical treatment gave good results if performed within 24 hours, penetrating keratoplasty yielding better results than lamellar keratoplasty.

When the cornea following damage became totally opaque (Grade IV), medical therapy led to perforation and loss of eyes. In these

cases also penetrating keratoplasty gave better results than lamellar keratoplasty.

Gurbax Singh
Deptt. of Ophthalmology,
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GASTROENTEROLOGY:

Diagnostic serum monoamine oxidase in portal hypertension

A study was undertaken to ascertain the value of serum Monoamine Oxidase (MAO) levels in differentiating portal hypertension resulting from postnecrotic cirrhosis, non cirrhotic portal fibrosis, extrahepatic portal hypertension and Budd-Chiari syndrome.

Serum MAO levels were estimated in 134 individuals-35 normal subjects, 61 patients with portal hypertension, 18 patients with congestive cardiac failure and 20 with diseases other than portal hypertension and congestive cardiac failure and a correlation was attempted with liver function tests and hepatic sinusoidal pressure. It was found that in quite a few cases of cirrhosis of the liver, Budd-Chiari syndrome and congestive cardiac failure the serum MAO levels were elevated. In the cirrhotics there was a significant correlation of the MAO levels with the hepatic sinusoidal pressure and the serum bilirubin levels.

The serum MAO levels were not elevated in cases of presinusoidal hypertension (extra-hepatic portal hypertension and non-cirrhotic portal fibrosis), though there was some overlap with values in the cirrhotics, Budd-Chiari Syndrome patients and patients of congestive cardiac failure. Hence, its value in the differential diagnosis of pre and post sinusoidal portal hypertension is limited. However, estimation of serum MAO, when combined with other tests, may help in identifying the cause of portal hypertension.

R. Nath
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Postgraduate Institute of
Medical Education & Research
Chandigarh.

Publication:

Borthakur, P.C., Nath, R., Chuttanni, P.N. and Datta, D.V. (1974). Serum monoamine oxidase in portal hypertension. *Indian J. Med. Res.* 61: 1965.

ICMR NEWS

NATIONAL INSTITUTE OF NUTRITION, HYDERABAD

The Scientific Advisory Committee of the National Institute of Nutrition (NIN), met at NIN, Hyderabad, on the 26th and 27th July, 1976.

The Scientific Advisory Committee of the Food and Drug Toxicology Centre and the Scientific Advisory Committee of the Laboratory Animal Information Service (LAIS) Centre, met at NIN, Hyderabad, on 28th July, 1976.

Dr. S.G. Srikantia, Director, NIN, Hyderabad, attended the meeting of the ICRISAT/CIMMYT/UNDP/FAO Policy Advisory Council at Mexico from 3rd to 7th August, 1976.

INSTITUTE FOR RESEARCH IN REPRODUCTION (IRR), BOMBAY

Dr. Karan Singh, Union Minister for Health and Family Planning, visited the Institute for Research in Reproduction, Bombay, on 7th August, 1976.

The Scientific Advisory Committee of the Institute for Research in Reproduction (IRR), Bombay met on 11th August, 1976.

Dr. Shanta S. Rao, Deputy Director, Institute for Research in Reproduction, Bombay, participated in the sixth International Congress of the Primatological Society held at Cambridge, U.K., from 23rd to 27th August, 1976.

The Scientific Advisory Committee meeting of the Blood Group Reference Centre was held at Bombay on 12th August, 1976.

BLOOD GROUP REFERENCE CENTRE, BOMBAY

The Scientific Advisory Committee meeting of the Virus Research Centre was held at Poona on 13th August, 1976.

VIRUS RESEARCH CENTRE, POONA

The Scientific Advisory Committee meeting of the National Institute of Occupational Health met at Ahmedabad on 30th August, 1976.

NATIONAL INSTITUTE OF OCCUPATIONAL HEALTH, AHMEDABAD

The Scientific Advisory Committee of the National Institute of Occupational Health met at Ahmedabad on 30th August, 1976.

INSTITUTE OF MEDICAL STATISTICS

Leading Statisticians and Health Administrators of the country met under the Chairmanship of Dr. C.R. Rao, Director, Indian Statistical Institute, Calcutta, on August 10, 1976 at the ICMR, New Delhi, to discuss the aims and objectives of the new Institute of Medical Statistics.

ICMR AIDED SYMPOSIA/SEMINARS/WORKSHOPS

An International Symposium on "Host Virus Interaction" organised by the Institute of Medical Sciences, Banaras Hindu University, Varanasi will be held in October, 1976.

A workshop is being organized on the "Role of Paediatricians in the delivery of health care" at Srinagar in October, 1976.

A Symposium on "Biochemical and Allied Subjects" is being organised by the National Institute of Nutrition, Hyderabad from 12th to 14th November, 1976.

A "Second National Symposium on Cryogenics" is being organised by the Indian Institute of Technology, Madras from 8th to 10th December, 1976.

A symposium on "Prophylactic Measures to Combat Deficiencies of Fat Soluble Vitamins" is being organised at the Indian Institute of Sciences, Bangalore, on 10th and 11th December, 1976.

The 9th Annual Conference of the Indian Pharmacological Society is being held at the Institute of Medical Sciences, Banaras Hindu University, Varanasi, in December, 1976.

A symposium on "Nutrition, Communicable Diseases and Priorities of Health Care in Developing Countries" will be organised as a part of the Silver Jubilee Celebrations of Trivandrum Medical College in December, 1976.

The Silver Jubilee Conference of the Anatomical Society of India is being held at the K.G. Medical College, Lucknow, from 29th December, 1976 to 1st January, 1977.

INDIAN COUNCIL OF MEDICAL RESEARCH RESEARCH FELLOWSHIPS

Applications are invited for the following fellowships for research in the field of bio-medical sciences:-

- | | | |
|------------------------|---|--|
| 1. Junior Fellowships | Rs.400/- p.m. for the first year
Rs.450/- p.m. for the second year
Rs.500/- p.m. for the third year | M.Sc./M.A./B.D.S.
M.V.Sc., M.S.W., M. Pharma or
B. Pharma. with three years research experience, or equivalent qualifications. |
| 2. Senior Fellowships | Rs.600/- p.m. | M.B.B.S., should have completed internship or M.Sc. with at least 3 years research experience. |
| 3. Research Associates | Rs.700/- p.m. to Rs.1100/- p.m. The actual value will be determined on the basis of qualifications and research experience. | A doctorate Degree in Medicine or Science viz. M.D., Ph.D. or equivalent qualification with research experience. |

The above fellowships will be awarded for specific time bound research projects to be carried out in the permanent Institutions of the Council, other Biomedical Research Institutes, Medical Colleges and Universities in the Country.

Full details and application forms obtainable from the Director-General, Indian Council of Medical Research, Post Box No.4508, Ansari Nagar, New Delhi-110016. Applications will be received throughout the year.

COUNCIL'S TRAINING PROGRAMMES FOR 1976-77

(A) EXISTING ANNUAL TRAINING COURSES:

Nutrition and Endocrinology:

At the National Institute of Nutrition, Hyderabad.

- (1) Annual Certificate Course in Nutrition; (December 1, 1976 to February 28, 1977)

- (2) Ninth M.Sc. (Applied Nutrition) Course: (June 1, 1976 to February 28, 1977)

- (3) *Fourth Annual Certificate Course in Human Nutrition for Teachers in Agricultural Universities.

- (4) Fifth Annual Training Course in Endocrinological Techniques and their

application: (August 19 to September 30 1976)

Reproductive Biology and Fertility Control:

At the Institute for Research in Reproduction, Bombay.

- (1) Annual Training Course in Reproductive Endocrinology: (September 15, 1976 to October 15, 1976)
- (2) Seventh Annual Training Course in Reproductive Biology and Fertility Control: (November 1, 1976 to February 28, 1977)
- (3) Sixth Annual Training Course on Hormone Assays: (February 1, 1977 to March 31, 1977)

Haematology:

At the Blood Group Reference Centre, Bombay.

Training Course in Blood Banking and Basic Haematology for Technicians (February 16, 1976 to May 15, 1976)

Amoebiasis:

At the School of Tropical Medicine, Calcutta.

Technicians Training Course on Amoebiasis: (April 1, 1976 to June 30, 1976)

Biostatistics:

At the National Institute of Nutrition, Hyderabad.

Third Annual Training Course in Biostatistics for Statisticians and Medical Research Workers: (September 1976)

Animal Technicians Training:

At the Laboratory Animal Information Service, National Institute of Nutrition, Hyderabad.

Ninth Annual Animal Technicians Training Course: (September 1, 1976 to November 30, 1976)

Virology:

At the Virus Research Centre, Poona.

Diploma Course in Virology of Poona University (July 1, 1976)

Clinical Pharmacology:

At the Department of Pharmacology, Seth G.S. Medical College, Bombay.

A Training Course in Clinical Pharmacology and Drug Evaluation: (January 15, 1977 to February 28, 1977).

(B) NEW TRAINING COURSES DURING 1976-77:

Reproductive Biology and Fertility Control:

At the Institute for Research in Reproduction, Bombay.

Course in Cytology and Cytogenetics: (September, 1976)

Occupational Health:

At the National Institute of Occupational Health, Ahmedabad.

- (1) ICMR/WHO Training Course of Evaluation and Control of Industrial Environment: (February 16-28, 1976)
- (2) *Training Course on the organizationa of Occupational Health Programmes in Industry:

Haematology:

At the Blood Group Reference Centre, Bombay.

A certificate course in Blood Banking Technology and basic Haematology for medical Officers for a period of eight weeks (February 1, 1977 to March 31, 1977).

(C) COURSES FOR TALENT SEARCH SCHEME FELLOWS:

Clinical Chemistry and Instrumentation:

At the National Institute of Nutrition, Hyderabad (March 1-10, 1976)

Cell-Biology and Cyto-Genetics:

At the Indian Institute of Science,
Bangalore: (April 12-21, 1976)

Principles and Methods in Medical Statistics:

At the Tuberculosis Chemotherapy Centre,
Madras: (December, 1976)

Immunological Techniques:

At the Department of Biochemistry, All
India Institute of Medical Sciences,
New Delhi: (January 24, 1977 to Feb-
ruary 5, 1977)

SCIENTIFIC LECTURES TO BE HELD AT
INDIAN COUNCIL OF MEDICAL RESEARCH HEADQUARTERS OFFICE
DURING SEPTEMBER AND OCTOBER, 1976

Date	Topic	Speaker
23.9.1976	Reverse smoking and carcinoma of hard palate in coastal Andhra (Sandoz Cancer Research Award Oration)	Dr. C.R.R.M. Reddy, Visakhapatnam
15.10.1975	Virology in Public Health: Not an island entire in itself (Basanti Devi Amir Chand Prize Oration)	Dr. K.M. Pavri, Poona
29.10.1976	Long term effects of Vasectomy	Dr. Shanta S. Rao, Bombay

ICMR PUBLICATIONS

TECHNICAL REPORTS

	Price Rs.
1. Research in Medical Education 1970	4.00
2. Research in Health Practices 1970	4.00
3. Acute Encephalopathy Syndrome in Children 1970	4.00
4. Technical Review on Pneumoconiosis in India 1970	4.00
5. Exfoliative Cytology 1971	4.00
6. Symposium on Nutrition and Heart Disease 1971	4.00
7. Developments in Industrial Psychology in India 1971	4.00
8. Study Group in Urolithiasis 1971	4.00
9. Proceedings of Seminar on Immunity and Immunoprophylaxis in Cholera 1971	4.00

10. Assessment of the National Filaria Control Programme (India, 1961-70) 1971	4.00
11. Diagnosis and Treatment of Pesticide Poisoning 1971	4.00
12. Symposium on Clinical Evaluation of New Drugs 1972	4.00
13. Techniques in Blood Group Serology 1972	4.00
14. Laboratory Methods in Investigation of Thyroid Diseases 1972	4.00
17. Proceedings of the First Annual Meeting of the Indian Academy of Cytologists 1972	4.00
18. Growth and Physical Development of Indian Infants and Children 1972	4.00
19. Review of Work Done in Rural Water Supply in India 1972	4.00
20. Genetics and our Health 1972	4.00
21. All India Conference on Research in Reproduction and Fertility 1973	4.00
22. A study of Morbidity Patterns and Standard of Medical Care in the Rural Health Centres of West Bengal 1973	4.00
23. Proceedings of the First All-India Workshop Conference on Stroke, 1973	4.00
24. Seminar on Infectious Hepatitis and Study Group on Australia Antigen, 1973	4.00
25. Atlas of Histopathology of Liver: Hepatitis and Cirrhosis, 1974	10.00
26. Studies on Pre-school Children 1974	4.00
27. Studies on Weaning and Supplementary Foods 1974	4.00

SPECIAL REPORTS

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4. Review on Haematology with a note on criteria for averages and normals (1953) (Special Report No.26)	1.00
5. Treatment and Hygienic Disposal of Lac Wastes by T.R. Bhaskaran (1954) (Special Report No.28)	0.62
6. A review of Work on Indian Medicinal Plants by R.N. Chopra and I.C. Chopra (1955) (Special Report No.30)	3.00

7. A review of Work Done on Infant Mortality by D.M. Satur and S. Bhatia (1957) (Special Report No.32)	1.00
8. Proteins in Foods by S. Kuppaswamy, M. Srinivasan and V. Subramanyan (1958) (Special Report No.33)	2.00
9. Tuberculosis in India: A Sample Survey, 1955-58 (1959) (Special Report No.34)	2.00
10. Physiological Norms in Indians: Pulmonary Capacities in Health by M.N. Rao, A. Sen Gupta, P.N. Saha and A. Sita Devi (1961) (Special Report No.38)	3.00
11. Treatment and Disposal of Sugar Factory Effluents by T.R. Bhaskaran, R.N. Chakraborty, N. Das and S.N. Sinha (1961) (Special Report No.39)	1.00
12. Nutrition for mother and child by P.S. Venkatachalam and L.M. Rebellow (1962), 2nd Edition 1971 (Special Report No.41)	1.50
13. Manual of Standards of Quality for Drinking Water Supplies (1962), Second Edition 1975 (Special Report Series No.44)	1.00
14. Manual of Methods for the Examination of Water Sewage and Industrial Wastes (1963) (Special Report No.47)	4.50
15. Utilization of Liquid Wastes from Molasses Distillery for Recovery of Potassium Salts by R.N. Chakraborty and T.R. Bhaskaran (1964) (Special Report No.49)	0.50
16. Occupational Health Research in India: A Second Review by M.N. Rao and B.B. Chatterjee (1964) (Special Report No.50)	Gratis
17. Nardostachys jatamansi - A Chemical, Pharmacological and Clinical appraisal by R.B. Arora (1965) (Special Report No.51)	4.50
18. Dietary Allowances for Indians by C. Gopalan and B.S. Narasinga Rao (1968) Reprinted in 1974 (Special Report No.60)	4.00

(Available from Division of Publication & Information, Indian Council of Medical Research,
Ansari Nagar, New Delhi-110016.

MEDICINAL PLANTS OF INDIA

The Indian Council of Medical Research is bringing out a monograph on medicinal plants of India in two volumes. The monograph presents, for the first time, in a systematic way, highlights of researches conducted (between 1960-1972) on medicinal plants. Thus apart from the botanical (including pharmacognostic), phytochemical, pharmacological and clinical data, the Monograph presents the Ayurvedic description of the plants (including synonyms, properties, actions and uses as indicated in various Ayurvedic treatises) along with illustrations of the plants. A glossary of Sanskrit/Ayurvedic terms has also been incorporated to help the readers. The Monograph also provides a list of plants classified on the basis of their pharmacological properties (indicating also the active chemical principles, wherever available).

Volume I of the Monograph comprising 350 species of medicinal plants presented in alphabetical order has just been released. Volume II featuring another 350 plant species is under preparation and is likely to be ready for the press by the end of 1976.

Those who are desirous of procuring Volume I of the Monograph (price Rs.30/-, postage extra) may book in advance as limited number of copies are available. For details, contact Chief, Division of Publication and Information, Indian Council of Medical Research, New Delhi-110016.

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