

REVUE DU VER A SOIE

(*BOMBYX MORI* L.)

JOURNAL OF SILKWORM

A V I S

*Toutes les demandes
de renseignements doivent
être adressées :*

à M. SCHENK André,
SECRÉTAIRE GENERAL DE LA
COMMISSION SERICICOLE
INTERNATIONALE.

28, Quai Boissier de
Sauvages

Téléphone : 86.21.94

ALES - (Gard).

PARTICIPATION FINANCIERE ANNUELLE :
10 Nouveaux Francs Français.

N O T I C E

*For all information
please apply to :*

Mr SCHENK André,
:GENERAL SECRETARY OF
THE INTERNATIONAL SERICULTURAL
COMMISSION

28, Quai Boissier de
Sauvages

Téléphone : 86.21.94

ALES - (Gard).

ANNUAL FINANCIAL CONTRIBUTION :
10 New French Francs.

Première Partie.

SECTION RACES.

- Etude de certaines races bivoltines de vers à soie, *Bombyx mori* L. en Egypte, par MM. HASSANEIN H., IBRAHIM M., EL-CHARAWY F. (R.A.U.).
- Races de vers à soie en Inde, par M. JANAKIRAMAN A. T. (Inde).
- Génétique et endocrinologie chez les vers à soie. L'hérédité du type métabolique, par M. JUCCI C. (Italie).
- Préparation des hybrides avec des races italienne et chinoise. Résultats. (Note Préliminaire), par Mlle LOMBARDI P. L. (Italie).
- Etudes des mutations génétiques par radiation chez le ver à soie, communiqué par M. TAZIMA T. (Japon).

Deuxième Partie

SECTION MALADIES.

- L'induction des viroses nucléaire et cytoplasmique chez le ver à soie. La résistance à ces maladies, par M. ARUGA H. (Japon).
- Etude de l'effet des préparations insecticides DDT et Hexachloran sur les vers à soie, par M. KOJOUKHAROFF I. (Bulgarie).
- Les maladies affectant les vers à soie en Inde, par M. JANAKIRAMAN A. T. (Inde).

Troisième Partie.

SUPPLEMENT

- Les maladies affectant les mûriers en Inde, par M. JANAKIRAMAN A. T. (Inde).
- Recherches fondamentales pour assurer la production de cocons au Japon, par M. YOKOYAMA T. (Japon).

First Part.

RACES SECTION

- Studies on certain bivoltine races of the silkworm, *Bombyx mori* L. in Egypt, by MMrs HASSANEIN H., IBRAHIM M., EL-CHARAWY F. (U.A.R.).
- Silkworm races in India by Mr JANAKIRAMAN A. T. (India).
- Genetics and endocrinology in the silkworm. Heredity of the metabolic type, by Mr JUCCI C. (Italy).
- Preparation of hybrids with Italian and chinese races. Results. (Preliminary Note), by Miss LOMBARDI P. L. (Italy).
- Studies on radiation mutagenesis in the silkworm, communicated by Mr TAZIMA Y. (Japan).

Second Part

DISEASES SECTION.

- The induction of, and resistance to the nuclear and cytoplasmic polyhedroses in the silkworm by Mr ARUGA H. (Japan).
- Study on the effect of DDT and Hexachloran insecticides preparations on the silkworms, by Mr KOJOUKHAROFF I. (Bulgaria).
- Diseases affecting the Indian silkworm races, by Mr. JANAKIRAMAN A. T. (India).

Third Part.

SUPPLEMENT.

- Diseases of Indian mulberry, by Mr JANAKIRAMAN A. T. (India).
- Basic researches to assure the cocoon production in Japan, by Mr YOKOYAMA T. (Japan).

11ème CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960.

Première Partie

S E C T I O N R A C E S
(suite et fin)

PRESIDENCE : M. BAKUNIAK E. (Pologne).

VICE-PRESIDENCE : M. GVINEPADZIE C. (U.R.S.S.).

RAPPORTEUR GENERAL : M. JUCCI C. (Italie).

11ème CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960.

STUDIES ON CERTAIN BIVOLTINE RACES
OF THE SILKWORM (*BOMBYX MORI* L.)

By H.HASSANEIN, M.IBRAHIM, F.EL-CHARAWY (R.A.U.)(*).

The practice of sericulture for the production of silk was in a flourishing condition in Egypt during the Eighteenth century.

The Egyptian silk attained great repute on account of its actual weaving and of the favourable climate of the country.

In the nineteenth century, the silk production in the middle East as well as in Egypt was mitigated to a large extent by the ravages of pebrine disease. At the beginning of the twentieth century, the silk production was grown again more and more as regards encouraging and support by the government financial aid.

The government of the U.A.R. is giving now a big support to the sericulture industry. It secured the most desirable mulberry varieties available and planted trees all over the country. Many varieties of the silkworm grains are imported from different countries in order to make comparative studies.

The present work is a detailed biological and technological study on some bivoltine races.

REVIEW OF LITERATURE.

CHAROBIM (1925) carried out a biological study in France on certain silkworm races : Bagdad, Chypre, White Chinese, Oro Chinese, White Japanese and the race Var. He concluded that the race Var is considered the best race fit for breeding in Europe especially France.

(*) Mr H. HASSANEIN, Mr M. M. IBRAHIM, Mr F. EL-CHARAWY, Apiculture and Sericulture Section, Plant Protection Department, Ministry of Agriculture, Region Egypt, U.A.R.

LOMBARDI (L.P.) (1951) studied the characters of two races : S.A. N° 64 and S.A. N° 88 for 12 years. The races S.A. N° 64 is a yellow cocoon breed gave about 90 kg of fresh cocoons for one ounce of grains, the medium length of the seric bave was about 1,000 meters with a titre of 2.5 deniers, 3/4 the filament was of good quality and little defaults. It was crossed with S.A. N° 2 and have a bave with a titre 2.5 deniers.

SCHENK and FRAISSE (1951) carried out investigations on fourteen different types of the silkworm, and noted their attitude for industrial filature, their silk yield and also the physical characteristics of the obtained raw silk (elasticity, tenacity, winding, neatness and regularity). The following results were clearly shown from their study.

1. The number of dried cocoons per kilo from 1040 to 1640.
2. Percentage of the weight of the curls (frisons) in comparison to the weight of the cocoon shell ranged from 17.6 to 26.2 % (difference of 55 %).
3. Entry into the basin (number of kilo dry cocoons for 1 kilo of silk) from 3.26 to 4.92 (difference of 60 %).
4. Neatness (from the scriplane, in percentage) from 87 to 92.
5. Tenacity (for 15 deniers size) from 49 to 61 grammes.
6. Elasticity (for 15 deniers size) from 21.8 to 48.8 %.

The conclusion showed that : two of these types were good, nine were medium, and three were deficient.

VAGO (1951) made his observations on the cause of the unsuccessful number rearing of silkworms. He mentioned that the high enfeeblement and mortality were observed in the successive summer rearing. They were attributed to physiological factors, food and climate but VAGO's investigations put forward two distinct etiologic factors :

- A. The mortality was only caused by a highly infectious disease which was favoured by the succession of rearings.
- B. The food and climate factors caused only the enfeeblement of worms and the decrease of the silk yield.

SCHENK and LEGAY (1951) presented a study of silkworm layings of which the following characters were measured :

1. Total weight of the laying (P)
2. Total number of laying eggs (N)
3. The individual average weight : $P = \frac{P}{N}$

First it was pointed out that layings with light eggs and layings with heavy eggs could be separated. Then the authors proved that in each laying the total weight of eggs P and the total number of eggs N of each laying were strictly connected 07901.

LEGAY J.M. and BAUD L. (1956) reported that the duration of the necessary and facultative periods of alimentation, expressed in number of meals, are clearly different between the three-moulting and the four-moul-

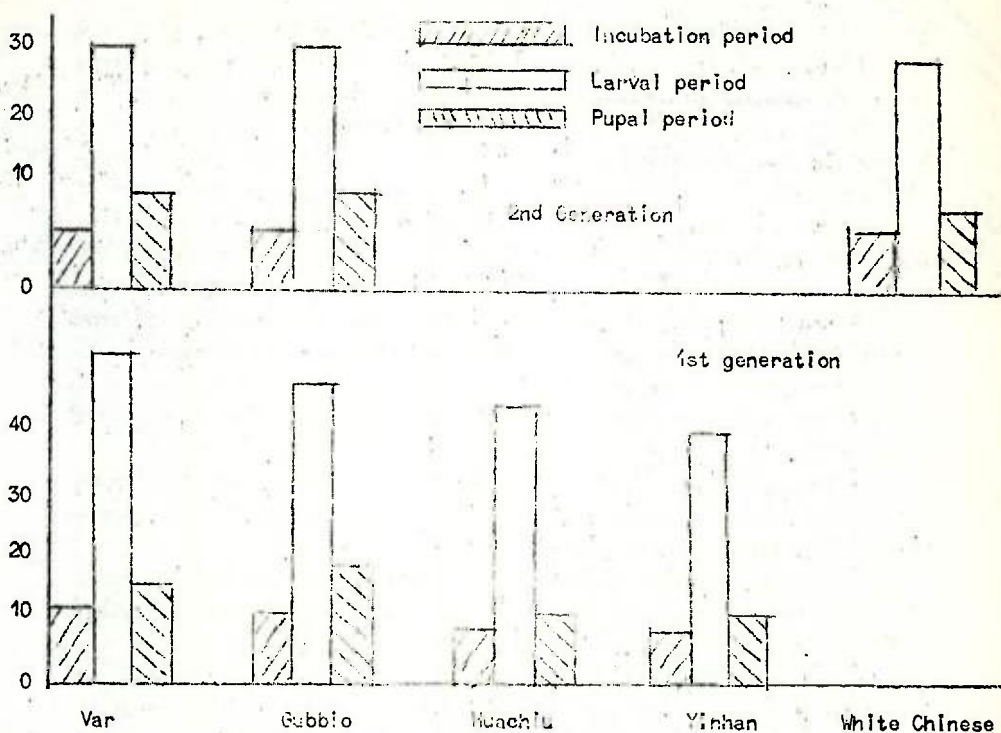


FIG. 1 - LIFE-CYCLE OF THE DIFFERENT RACES (1957).

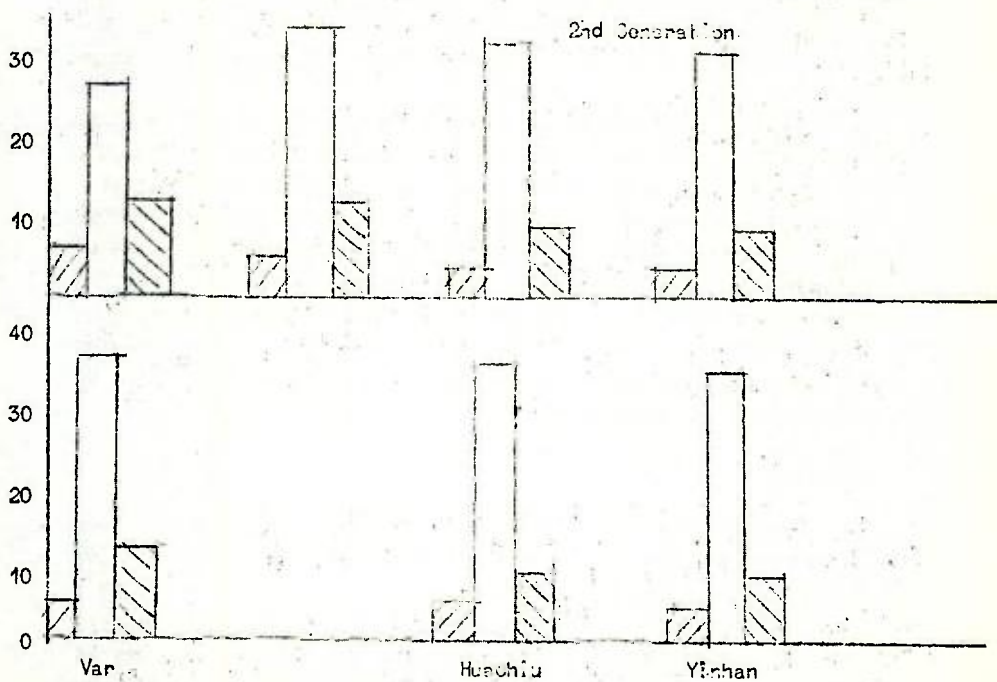


FIG. 2 - LIFE CYCLE OF THE DIFFERENT RACES (1956).

ting races during the last stage only. The weight of cocoons shells, and the pupae^{are} lighter in the three-moulting races than in the four-moulting ones. The ponderal dimorphism linked to the sex is equally important in the three moulting and in the four moulting races. The silk secretion is proportionally more active during the last stage among the three-moulting than among the four-moulting races. The total weight, the number of normal eggs laid and the average weight of one egg in the three-moulting races are smaller than the ones in the four-moulting races regarding the absolute value and nearly equivalent regarding to the relative value.

LOMBARDI (1956) studied the behaviour of eggs of bivoltine and cross mono-bivoltine races in comparison with eggs of monovoltine races.

Her observations showed that :

A. The eggs of the cross mono-bivoltine and polyvoltine races must be detached from the paper or cloth in late autumn.

B. The eggs with a long aestivation and a very short hibernation did not leave residues at their hatching and the same held true if the aestivation was short and the hibernation was normal.

C. The complete hibernation was not advisable for monovoltine races but can be applied to those having the character of dominant or latent voltinism in regard to the residues of the hatching.

D. The eggs of bivoltine races did not hatch spontaneously the second time in the year and were concerned as monovoltine, give a large residue at the hatching. The authors on this basis described what precautionary measures must be taken for the bivoltine races and for the monovoltine and species that the reproduction or multiplication of the hybrids, species with a bivoltine background should not be practiced absolutely.

E. To render insignificant or non existent the presence of voltinism in the descendents, the races based on voltinism are raised 15-20 days, later in the zones where monovoltine races are raised, or the incubation was done after a single day of soaking 12° C. and at an humidity of 80%.

F. The egg production of these races is conserved from the act of laying in the date of hibernation at a middle temperature 25-26° C., a temperature which should be slowly lowered without a sudden changes.

G. The races and crosses with a base of voltinism; although showing a strong susceptibility against the diseases are extremely sensitive to the variations in the environment.

MATERIAL.

The silkworm races used in this study were the standard breeds of the bivoltine races. The races used in these investigations were Var, Gobio, Yinhan x Huachiu and White Chinese.

The Gobio and Var are considered as local races. They were bred in Egypt since the establishment of the Sericulture Department, Ministry of Agriculture in 1926. The hybrid Yinhan x Huachiu and its reciprocal crosses and the race White Chinese were imported from China.

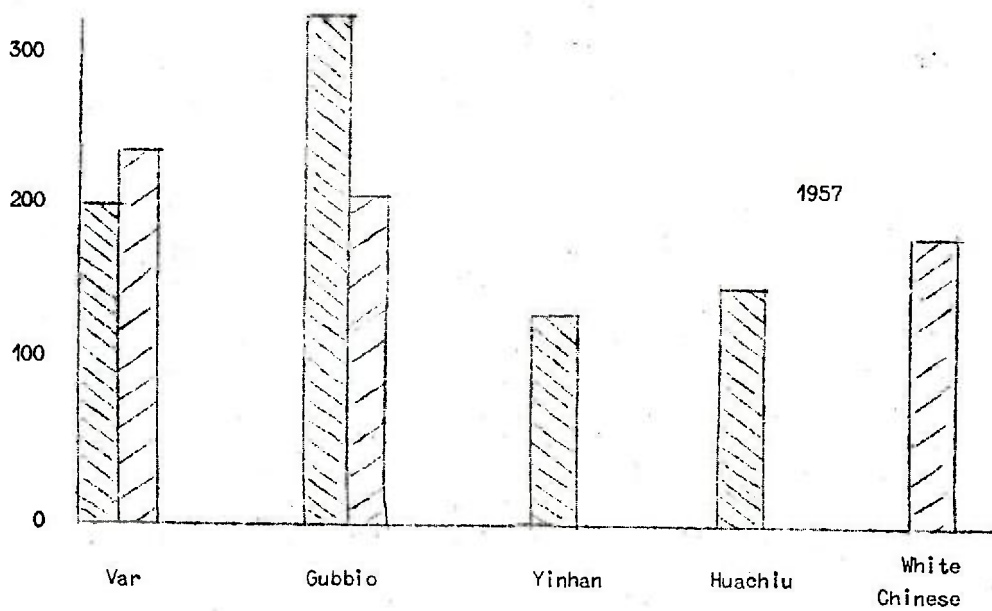
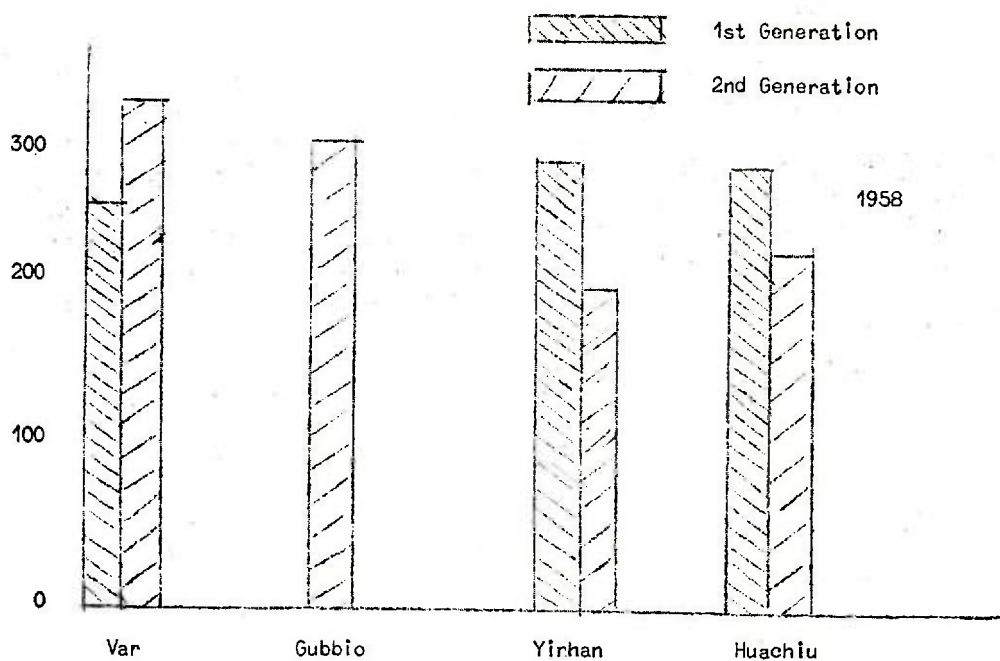


FIG. 3 - WEIGHT OF PUPA PER mgms IN THE DIFFERENT RACES.

METHODS : REARING METHOD.

The rearing method must be in accordance with the principal properties of the various species of the silkworms and properly controlled, so that the different breeds should not be mixed each other during the rearing period. Important points of technical treatments were noticed in rearing. Disinfection and antidiseases sanitation are very important measures against silkworm diseases. The rearing rooms and implements were disinfected. Environment sanitation during rearing. Stages were perfectly treated, precautions were taken against possibilities of infecting the silkworms with certain epidemic diseases which may be attached to the mulberry leaves in the orchards.

The rearing room was 12 meters by 6 and 5 meters in height from the floor to the double ceiling. The windows were on each side for the ventilation and light, but the direct rays of the sun upon the reared worms was looked to be avoided. It was quite sufficient for breeding 24 gms of grains. The wooden frames were supplied with 4 trays, each frame 2 meters by 80 cm with a border of seasoned wood and was lined with clean papers which were changed daily.

The various breeds of silkworms in the different rearing stages have different requirements, so it was necessary to feed them with properly matured leaves, not too tough nor too tender. The mulberry leaves were supplied to the worms 6 times daily and were given to the first and second larval instars as stripes, afterwards the diet was distributed in a manner that the larva do not suffocate. Dried leaves and faeces were removed at different intervals by using mosquito netting in the first larval instars, and perforated papers with sufficiently large holes for the other instars.

SPINNING.

A silkworm eats incessantly consuming more food during the last week than in all the rest of its life. Gradually its appearance changes, which indicates that the silk glands are preparing the silk and the worm is ready to make its cocoon.

Just before the silkworms reach this stage, bunches of Casuarine branches were placed along the trays, the tops being towards each other to form a series of arches. When thousands of silkworms evacuate, the rearing rooms become damp, so it is essential that it should be well ventilated and fresh heaps of quicklime were placed in the corner of the room. The silkworm after choosing the suitable site for spinning, starts to emit from its body a thick viscous protein which solidifies on contact with air into the silk bave.

Before making the actual cocoon the worm emits a coarse thread which attaches from one support to another until after five or six hours it makes a safety net from the middle of which it spins its cocoon.

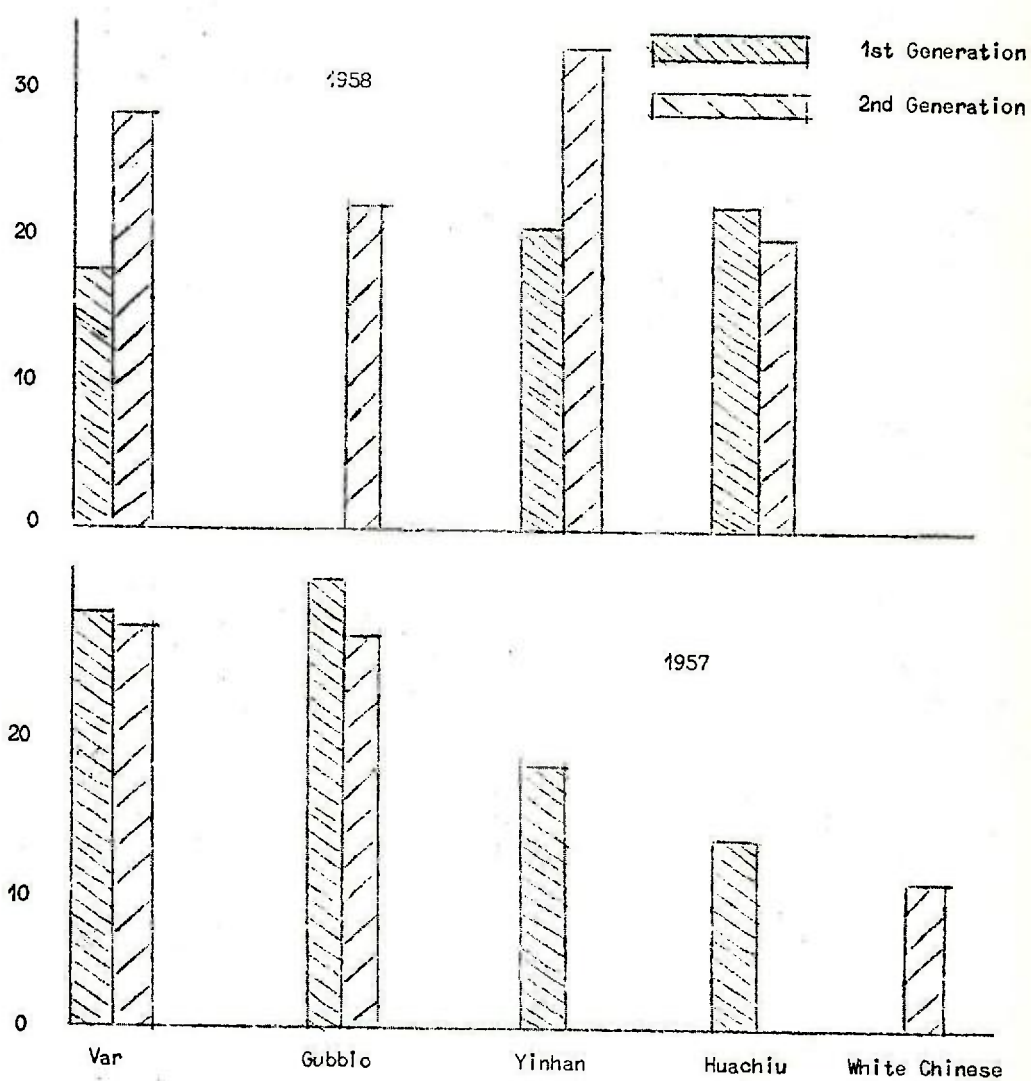


FIG. 4 - WEIGHT OF PELADE PER mgms IN THE DIFFERENT RACES.

BREEDING.

The selected cocoons for breeding were removed, stripped of the rough floss and carefully strung together in long "neck-laces" which were hung from hooks in a dry warm room.

After the emergence of the moths, the males seek the females and they mate. The coupled moths were then transferred by the wings to trays which were carried into a quiet room. At the end of the mating periods the moths were separated and the females were placed in paper bags where they lay their eggs.

SUFFOCATION AND DRYING OF COCOONS.

It is necessary to kill the chrysalis of the selected cocoon for the serie bave test before its transformation.

The simplest and easiest manner has been found to be submission of the living cocoons to the action of heat, for this purpose we used the desiccator.

It comprises essentially a fan in the drying chamber in which the fresh cocoons were placed, to maintain a constant air current through the mass of the chrysalides, which carries away the products formed during desiccation, and a stove for heating the air driven by the fan.

Desiccation was started at a temperature of 50-60° C. and was carried to a maximum of 90-95° C.

THE TECHNICAL METHODS.

In order to examine the nature of the bave, it is unwound from the cocoon by a special apparatus which provides, without occasioning any mechanical changes in it, for measuring the total length of the bave and for cutting it into any specified lengths for special examinations (resistance and elasticity, etc...).

The apparatus designed by DUSUZEAU (1886) and modified by VETSON and QUAIAT (1896) (after Paolo CAREONI 1846). It comprises a paralleliped in which the cocoon is placed after being softened by soaking, the water was heated by a gas jet under the container.

The winder on which the bave is reeled is provided with a goniometer and with a guiding arm with forward and backward movement along the whole length of the winding frame allowing the bave to be wound; required in separate skeins.

TENSILE PROPERTIES.

The dynamometric properties of the bave, as also those of raw silk, are measured by a special apparatus called a serimeter (fig. 13) in which a dynamometer records in grammes or decigrammes the weight required to break the thread, and is connected with another indicator that shows the length of the thread up to the breaking point.

The dynamometer used in serimeters consists of a single lever with elbow action of which the extremity of the long arm is in a graduated arc, while the other arm is connected with a small shaft on which there is a thread holder. In the serimeter shown in fig. 13, its fall is regu-

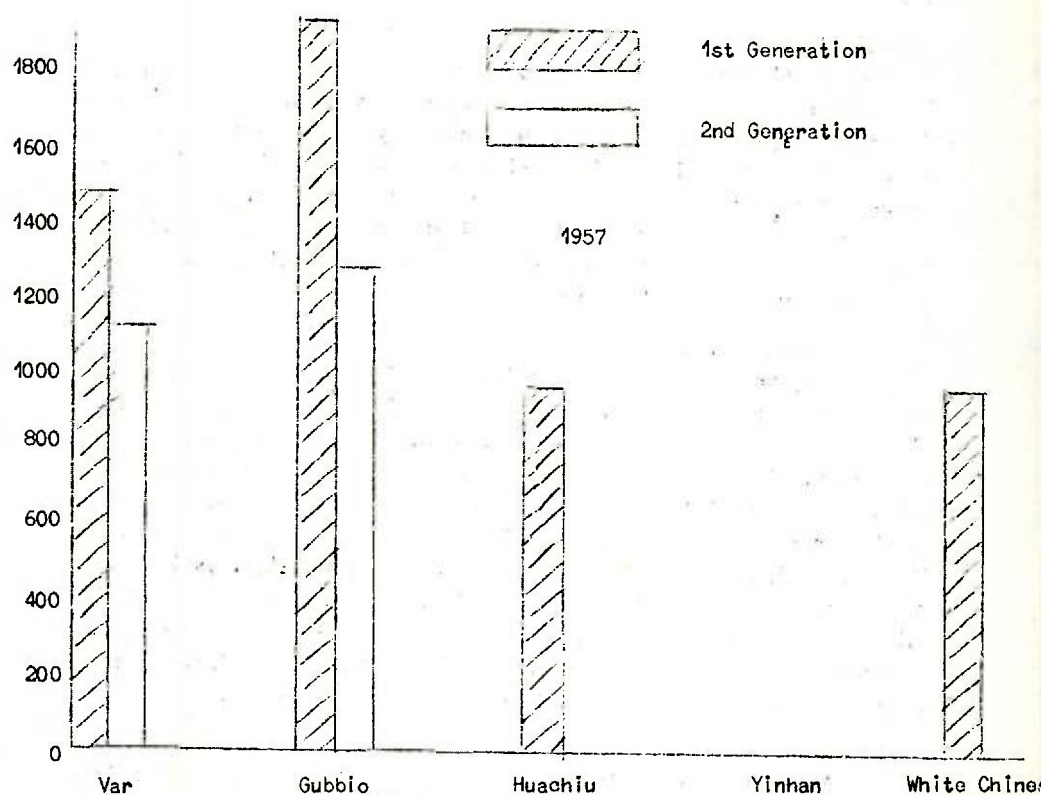
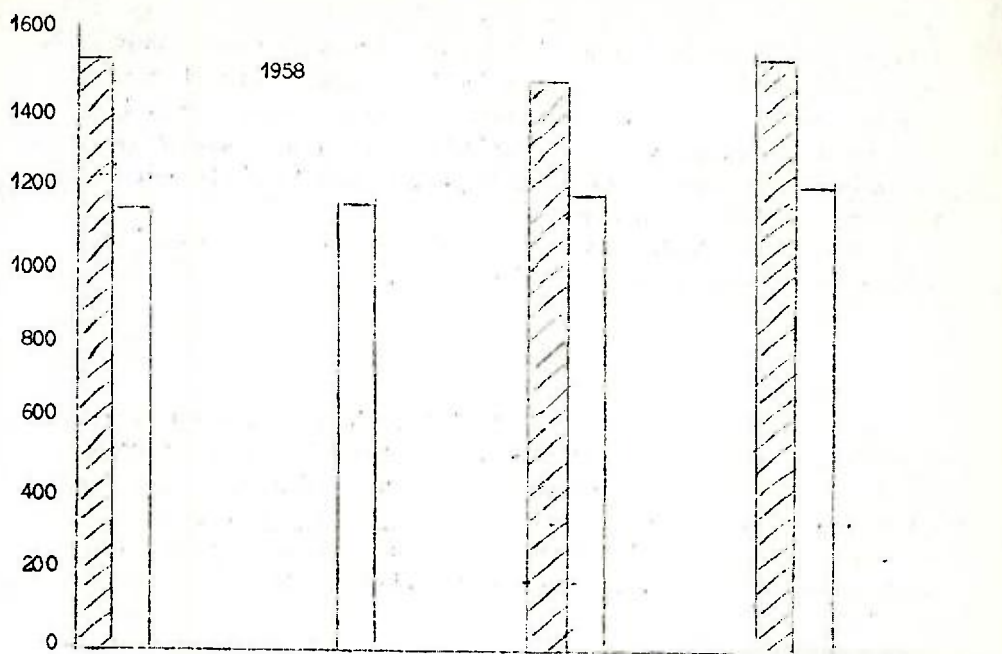


FIG. 5 - FRESH WEIGHT OF COCOON per 5ms IN THE DIFFERENT RACES.

lated by a small endless chain running on two sprockets, one of these though gears, works as a fan governor, which is called a chain serimeter. When the bave is being tested, stretched between the thread holders, it holds up the stopping lever of the fan which falls at once when the thread breaks immobilizing the second thread holder. A scale in millimeters indicates the elasticity of the thread.

A geared metal indicator attached to the top of the apparatus give the suspended weight in grammes or decigrammes.

RESULTS.

THE EGG.

After moulting the females deposit their eggs in the paper bags prepared for egg laying. The eggs vary according to the different races, they are either adherent or not adherent. In the present studies, the eggs of all the races are adherent. The eggs of silkworm Bombyx mori L., are yellow in colour after oviposition. then their colour changes gradually after two or three days into gray. The colour is greenish metallic grey in the race Gobio, pale metallic grey in the race Var, greenish grey in the race White Chinese and is copper grey in the two cross breeds Yinhan and Huachiu.

INCUBATION.

The Incubation period of the fertilized eggs is shown in table 1, it varies between 5 and 9 days at 23-25° C. and relative humidity 75 % in the first generation, while it was between 3 and 7 days in the second generation. At the end of the Incubation period the eggs became lighter in colour, and after hatching the egg shell became whitish yellow.

Hatching took place normally in the first hour of the morning. In the first day a few hatched larvae appeared gradually, the maximum number of the hatched larvae was in the second day.

THE LARVAL STAGE.

When the young larva starts hatching, it pierces the egg shell by eating a small part of its top, after a short while the young larvae starts feeding on the slices of mulberry leaf tissues, and usually secretes a silken thread. Fig. 192 and table 2 show the results of the breeding experiments at normal air shade temperature. The data indicate that the larval period ranged from 34 to 43 days in the two experimental years in the first generation, and 28 and 33 days in the second generation. It is clearly shown from table 2 that there was a little variation in the average duration of the larval stage in the different races during the experiment. The shortest larval stage was that of the race Yinhan in the first generation, and it was that of the race Var in the second generation.

MOULTING.

The young larva cast periodically the outer parts of the cuticle, this process is termed moulting or ecdysis. The chitinization of the epidermis or primary cuticle adds to its efficiency as an armor but it prevents the expansion of the body wall rendered necessary by the growth of the larva

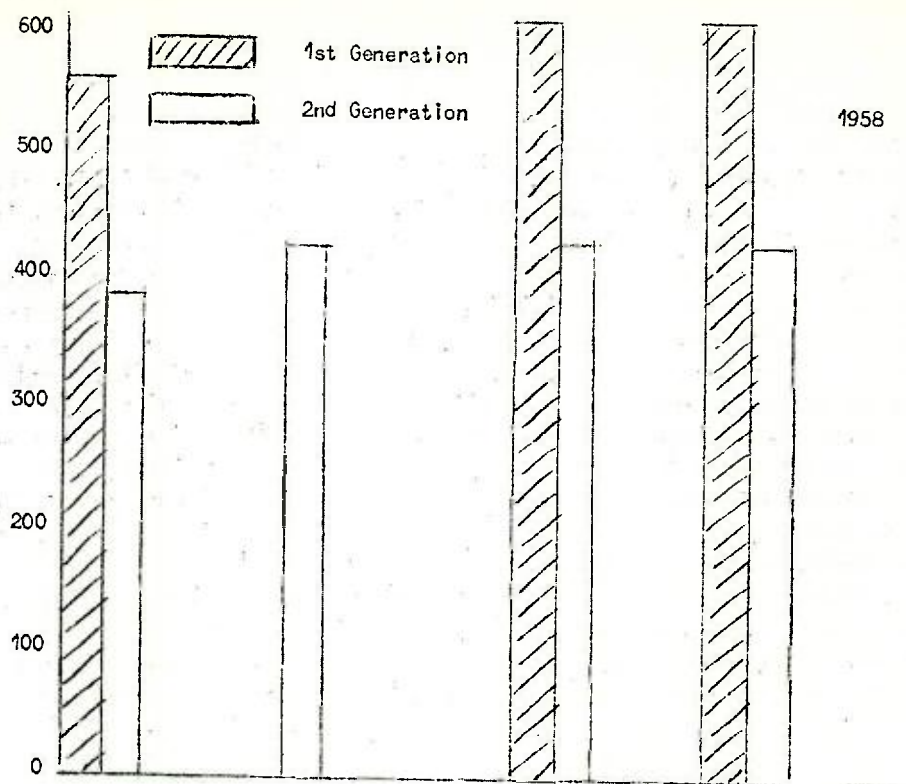
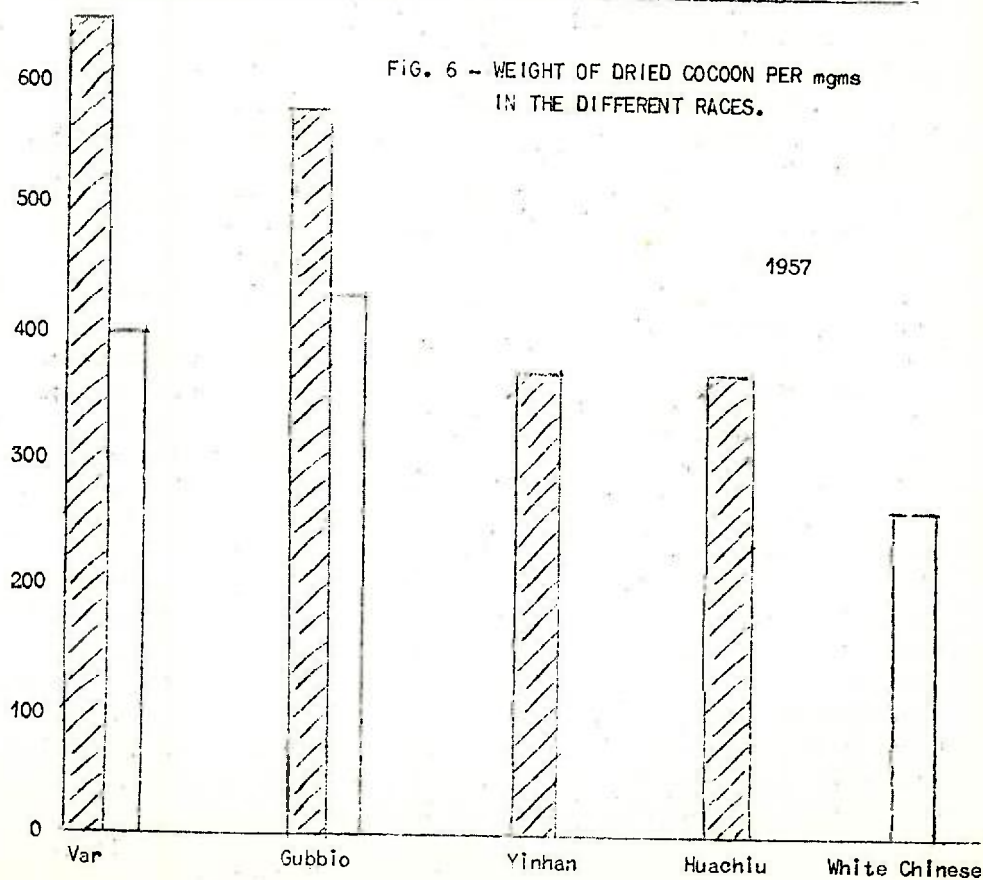


FIG. 6 - WEIGHT OF DRIED COCOON PER mgms
IN THE DIFFERENT RACES.



consequently as the body grows its cuticle becomes too small for it. When this occurs a second epidermis is formed by the hypodermis, after which the old epidermis split open, usually along the back of the head and the thorax, and the larva works itself out from it. Just before the moulting process, the silkworm loses its appetite and soon ceases feeding altogether contracts the abdomen and drives fluid into the head and thorax. It commonly assists this process by swallowing air. The larva fastens itself by the hind leg and raises its head in the air, and maintains on this position till the end of the moulting process. At the end of the moulting period the worm makes two or three sudden movements with its head and the cuticle by the head begins to split. The horny part which forms the mouth falls into the litter, then a split appears in the head itself, and a new head rises up the skin of the old one, which then drops off like a mask. By working its head from side to side the front part of the body is pulled through the opening, then, the worm rests, for a few minutes, and then gets to work again, it draws itself a little further out of its cuticle, gradually dragging itself further and further, forms its front legs. The worm remains motionless for a little while with its body stretched out at full length, thus allowing the epidermis time to dry and harden in the air. Coincident with the formation of the new epidermis new setae are formed, beneath the old epidermis. A very wide range of variation is exhibited with regard to the number of ecdysis by different insects. The silkworm Bombyx mori L. passes through three or four moulting stages in the different races. It is evident from the data obtained in table 3 that the experimental breeds were from the fourth moulting stage type. In 1957, the premoulting period ranged between 24 and 33 hours in the first premoulting period in the first generation and ranged from 33 to 36 hours in the second generation. In the second premoulting period it ranged from 24 to 48 hours in the first generation while it varied from 24 to 27 hours in the second generation. The third premoulting period ranged from 30 to 48 hours in the first generation and it was 30 hours in the second generation. The third premoulting period ranged from 30 to 48 hours in the first generation and it was from 36 to 48 hours in the second generation. In 1958, the first premoulting period ranged from 24 to 43 hours in the first generation, and ranged from 24 to 36 hours in the second generation. The second premoulting period was 48 hours in the first generation, while it ranged from 27 to 42 hours in the second generation. The third premoulting period ranged from 48 to 60 hours in the first generation and it varied from 21 to 39 hours in the second generation. The fourth premoulting period was 48 hours in the first generation and it ranged from 46 to 63 hours in the second generation.

It is evident from table 4 that the silkworm have five instars to reach its mature stage. In 1957 the first stadium ranged from 7 to 8 days in the first generation and it was 5 days in the second generation. The second stadium ranged from 5 to 7 days in the first generation and it was 4 days in the second generation. The third stadium ranged from 6 to 7 days in the first generation while it was 4 days in the second generation. The fourth stadium ranged from 5 to 8 days in the first generation and it

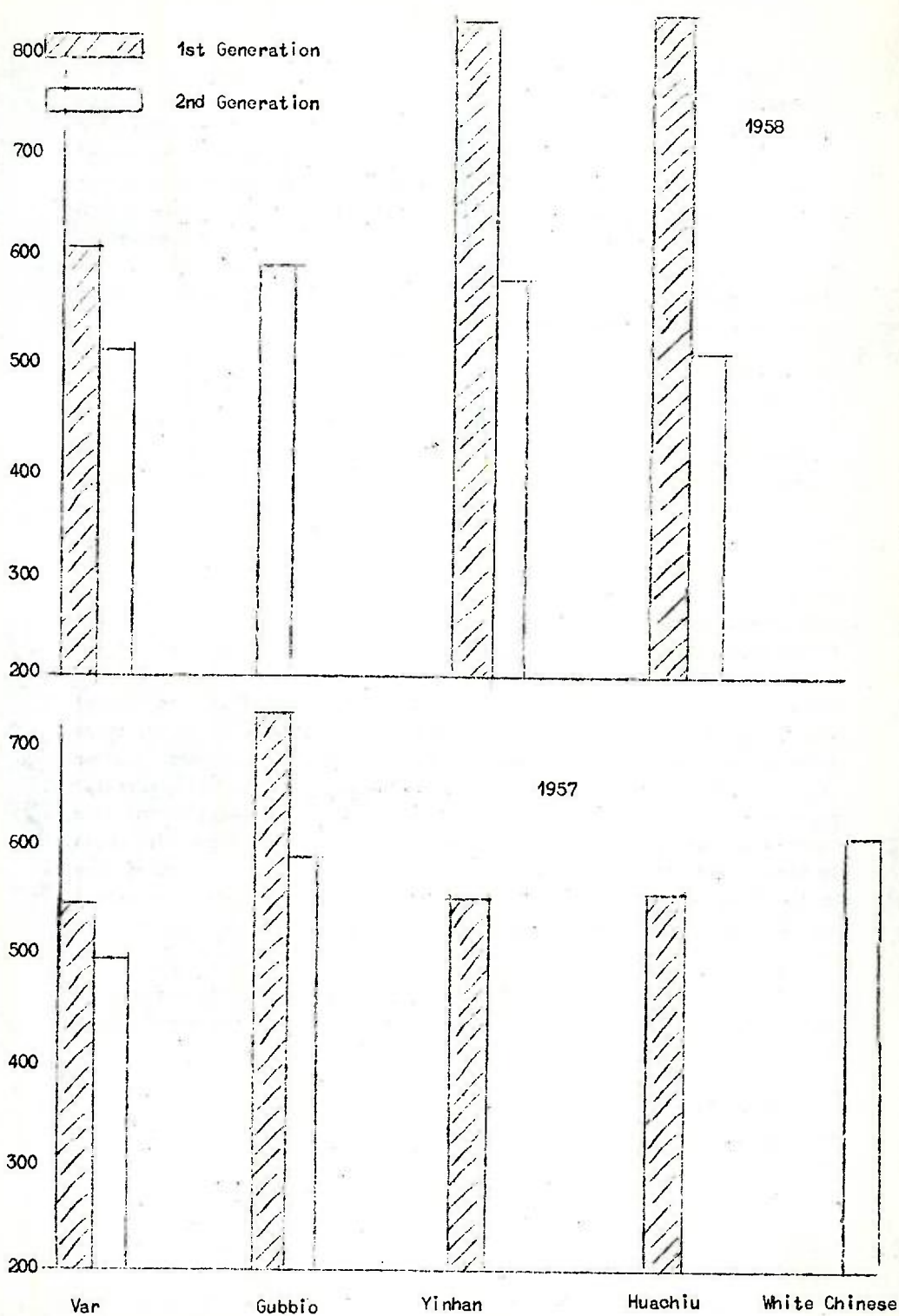


FIG. 7 - LENGTH OF SILK PER METERS IN THE DIFFERENT RACES.

was 5 days in the second generation : The last stadium ranged from 4 to 9 days in the first generation and it varied from 6 to 8 days in the second generation. In 1958 the first stadium was 7 days in the first generation while it ranged from 4 to 5 days in the second generation. The second stadium ranged from 4 to 5 days in the first generation and it ranged from 3 to 4 days in the second generation. The third stadium varied from 4 to 5 days in the first generation and it was 4 days in the second generation. The fourth stadium ranged from 4 to 6 days in the second generation. The fifth stadium ranged from 7 to 8 days in the first generation and it varied from 8 to 10 days in the second generation.

SPINNING.

The change from the larva to the pupa usually becomes cessation of feeding. The larva departs the mulberry leaves and wanders in search of a suitable site in which to undergo the pupation. The contents of the digestive canal are voided and the body becomes contracted and distended. The larva uses the substance contained in the sericteries for the spinning of its cocoon. It emits from its body a thick viscous protein solution which solidified on contact with air into a thread of silk called brins, but when cemented together by the adherent material constitute the silk fibre. Before making the actual cocoon, the worm emits a coarse thread which attaches from one support to another until after five or six hours, it has made a safety net from the middle of which it spins its cocoon, then it starts to construct the cocoon by seripositing the thread over itself in the form of figure 8 setting down little bundles of these doubling on every part of the cocoon. The worm takes about three to four days to complete its cocoon. The cocoon of Bombyx mori L. is generally regarded as making provision for shelter from adverse elements of the worm immobilized during its critical period of pupation. It is clearly shown in table 5 and fig. 14 that the pupal period ranged between 9 and 14 days at the first generation in the different races, and it ranged between 8 and 12 days in the second generation.

WEIGHT OF PUPA.

The average weight of pupa in the races reared in 1957 is recorded in table 6 and fig. 3. It ranged between 132 and 334 mgs in the first generation, while it ranged between 186 and 248 mgs in the second generation. In 1958 the average weight ranged between 274 and 296.2 in the first generation, while it ranged between 222 and 331.6 mgs in the second generation. The highest mean weight of pupa was in the race Gobio (// 334.9) in the first generation and it was 248.6 mgs in the race Var in the second generation. The least mean weight was in the cross breed Yinhan (122.3) in the first generation and it was 123.5 mgs in the race White Chinese in the second generation for the races reared in 1958, the highest mean weight of pupa was in the crossbreed Yinhan (229.9) in the first generation, while it was 331.6 mgs in the race Var in the second generation. The least mean weight of pupa was that of the race Var 274.2 mgs in the first generation and it was 222.1 mgs in the race Yinhan in the second generation.

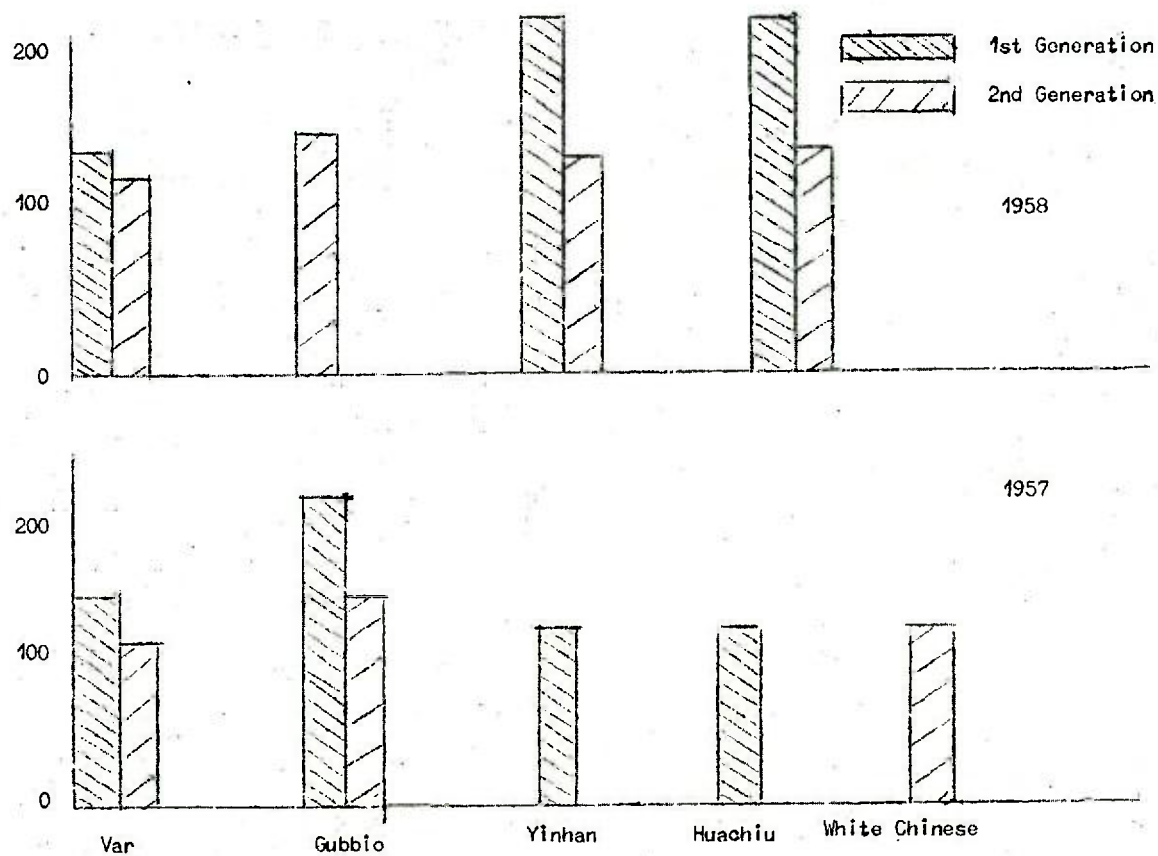


FIG. 8 - WEIGHT OF REELED SILK PER mgms IN THE DIFFERENT RACES.

THE PELADE.

The crust of the cocoon is formed by various layers of bundles more or less solidly interplated together, the internal layer which envelops the chrysalis is termed the pelade, this layer is considered as a waste silk, its weight varies in the different ranges, it varies between 17.4 and 29.9 mgs in the first generation, while it varies between 9.3 and 26.8 in the second generation. It is clearly shown in table 7 and fig.4, that the highest mean weight of pelade for the races reared in 1957 was 29.9 mgs in the race Gobio in the first generation while it was 26.8 mgs in the race Var in the second generation. The least mean weight of pelade was 11.4 mgs in the crossbreed Huachiu in the first generation and it was 9.3 mgs in the race White Chinese in the second generation. In 1958, the highest mean weight of pelade was 20.8 mgs in the crossbreed Huachiu in the first generation and it was 32.8 mgs in the crossbreed Yinhan in the second generation. The least mean weight of pelade was that of the race Var (16.5) in the first generation and it was 17.9 mgs in the crossbreed Huachiu in the second generation.

COLOUR OF COCOON.

The colour of the cocoon is one of the important characteristics that at least affected by the environment, cultivation, and breeding. The cocoon of the races Yinhan, Huachiu and White Chinese was white, while the cocoons of the races Var and Gobio was pale yellow.

SHAPE OF COCOON.

The common shape of the Bombyx mori L. cocoons are spherical, oval, and waisted, the spherical cocoons as in the race White Chinese. Cocoons are called oval in shape when the longitudinal axis is appreciably greater than the transverse, such as the cocoons of the Yinhan and Huachiu crossbreeds. Waisted or belted cocoons have a central contraction more or less accentuated such as the races Gobio and Var. If the contraction is pronounced it may be a serious obstacle in reeling the bave, because when the inner layers are reached, the cocoon tends to double up and get torn in the process ending as waste instead of thrown silk.

The length of the cocoon varies in the different races. Table 8 indicates the maximum length of cocoon for the races reared in 1957, it ranged from 8.0 to 11.1 cms with a mean value ranged from 7.4 to 10.5 cms in the first generation, while the maximum length of cocoon in the second generation ranged from 7.4 to 9.2 cms. The minimum length of cocoon varied from 6.2 to 10.0 cms, in the first generation and it ranged from 5.3 to 7.5 cms in the second generation. The highest length of cocoon was that of the race Gobio in the first and second generations. The least length of cocoon was that of the race Yinhan (7.4 cms) in the first generation, while the least length of cocoon was in the race White Chinese in the second generation. In the races studied in 1958, the maximum length of the cocoon ranged from 9.1 to 9.5 cms in the first generation and the minimum length ranged from 7.6 to 8.0 cms with a mean value 8.6 cms, while the maximum length ranged from 9.0 to 10.1 cms in the second generation and

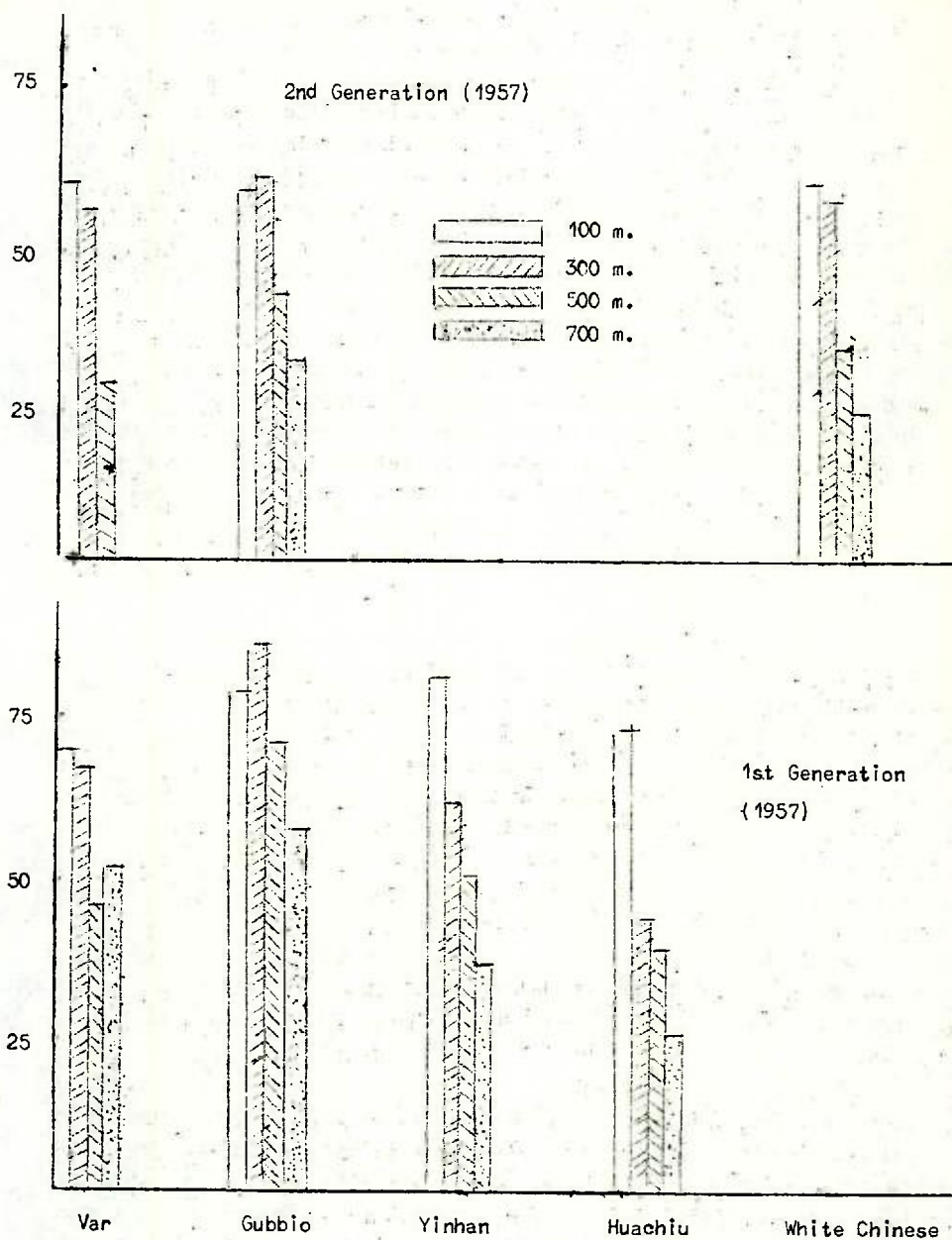


FIG. 9 - Resistance of the silk fibre per decigram in the different races on the dimensions 100, 300, 500 and 700 meters.

the minimum length ranged from 7.5 to 8.0 cms with a mean value ranged from 8.2 to 8.9 cms in the different races.

The highest length of cocoon was that of the race Gobio in the second generation. Width of cocoon was also measured in the different breeds. In the races reared in 1957, the maximum width of cocoon in the first generation ranged from 5.2 to 7.5 cms, the minimum width ranged from 4.0 to 6.4 cms with a mean width of cocoon was 7.2 cms. In the race Gobio, while the least length was 4.6 cms in the crossbreed Yinhan. In the second generation, the minimum width of cocoon ranged from 5.5 to 6.8 cms, the minimum width ranged from 5.4 to 4.2 cms with a mean value ranged from 4.1 to 2.7 cms in the different race. The highest width of cocoon was that of the races Gobio, while the least width of cocoon for the races reared in 1958 ranged from 5.5 to 6.3 cms, the minimum width ranged from 4.4 to 5.1 cms with a mean value ranged from 5.2 to 5.7 cms in the first generation. The highest width of cocoon was that of the race Yinhan. In the second generation the minimum width of cocoon ranged from 5.5 to 6.8 cms. The minimum length ranged from 4.2 to 5.4 cms with a mean value ranged from 4.9 to 5.8 cms in the different races. The highest width of cocoon was that of the race Gobio.

WEIGHT OF COCOON.

The cocoons show continuous loss of weight from the time of its completion until the maturity of the moth, due to the respiration of the chrysalis and simple evaporation. This loss of weight may be considerable. In the process of dessication, the weight of the cocoon is reduced by about two thirds, mainly by elimination of water. The average weight of the cocoon varies in a single strain according to the conditions of rearing, and also variations are found among breeds. Uniformity of individual weight of expected from them in the reeling process. Cocoons were separately weighed to determine their maximum, minimum and average weight.

Statistical analysis of the standard deviation was also recorded. Table 10 and fig. 5 indicate the maximum, minimum and average weight of the fresh cocoon of the different races in the first and second generation.

In 1957 the maximum weight of fresh cocoon ranged from 1.220 to 2.340 gms. The minimum weight varied from 0.640 to 1.750 gms with a mean value varied from 0.977 to 1.936 gms in the first generation. The maximum fresh weight of cocoon in the second generation varied from 0.956 to 1.700 gms, the minimum weight ranged from 0.560 to 700 gms with a mean value varied from 0.778 to 1.290 gms in the different races. It is clearly evident in table 11 that the highest mean weight of fresh cocoon in the first and second generation was that of the race Gobio.

Results of fresh weight of cocoon for the races reared in 1958 are presented in table 10 and illustrated in fig. 5. It may be noted that the maximum weight of fresh cocoon ranged from 1.810 to 2.163 gms, the minimum fresh weight ranged from 1.031 to 1.299 gms with a mean value

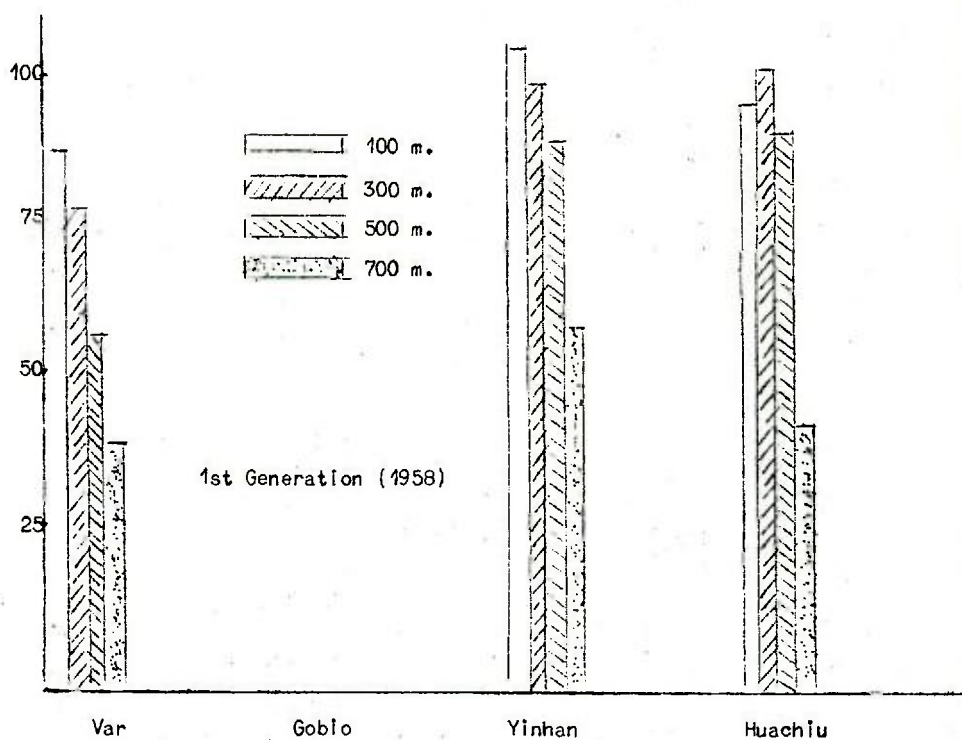
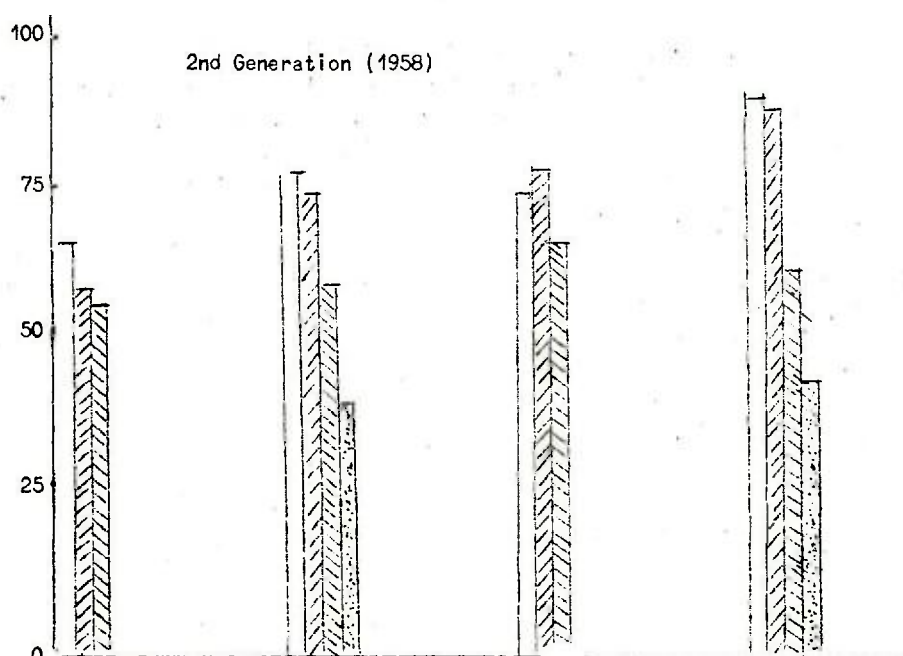


FIG. 10 - Resistance of the seric fibre per decigrams in the different races on the dimensions 100, 300, 500 and 700 meters.

ranged from 1.495 to 1.524 gms in the first generation, while the maximum fresh weight of cocoon in the second generation varied from 1.430 to 1.830 gms, and the minimum fresh weight varied from 0.700 to 1.220 gms with a mean weight of cocoon was that of the race Gobio.

The weight of dried cocoons has long been considered as an important factor on silk yield. Tests have been conducted to evaluate and study the maximum, minimum and average weight of the dried cocoon in the two generations during the two experimental years. It is clearly shown in table 41 and fig. 6 that the maximum weight of the dried cocoon for the races reared in 1957 in the first generation ranged from 464 to 504 mgms, the minimum weight varied from 200 to 590 mgms with a mean value ranged from 356 to 573 mgms, and the highest mean weight of the dried cocoon was that of the race Gobio. In the second generation, the maximum dried weight of cocoon ranged from 536 to 558 mgms and the minimum weight varied from 186 to 354 mgms with a mean value ranged from 271 to 443 mgms. The highest mean weight of the dried cocoon was that of the race Gobio. In 1958 the maximum dried weight of cocoon varied from 725 to 996 mgms and the minimum weight ranged from 396 to 510 mgms with a mean value ranged from 559 to 613 mgms. The highest mean weight of dried cocoon in the first generation was that of the race Yinhan. In the second generation, the maximum weight ranged from 595 to 720 mgms and the minimum weight ranged from 320 to 412 mgms with a mean value varied from 380 to 442 mgms. The highest mean weight of dried cocoon in the second generation was that of the race Yinhan.

The seric bave.

The seric bave is composed of two brins united together by sericin. With the exception of the first layers, which constituted the crust or husk of the cocoon, the seric bave is deposited in the cocoon with a certain regularity in the form of loops or eyelids. In order to examine the nature of the bave it is reeled from the cocoon by a special apparatus for measuring the total length of the seric filament and for cutting it into any special lengths for special examinations.

Length of the seric filament.

The length of the reeable filament varies greatly in the different breeds, for the measurement, cocoons of the different breeds are reeled and their lengths are reported in table 12 and illustrated in fig. 7. In 1957 the maximum length of the seric filament ranged from 780 to 270 meters, and the minimum length ranged from 130 to 340 meters with a mean value ranged from 535 to 714.3 meters in the first generation. The highest mean length of silk in the cocoon was that of the race Gobio. In the second generation, the maximum length of silk in the cocoon ranged from 695 to 860 meters and the minimum length ranged from 270 to 385 meters with a mean value varied from 493.40 to 591.6 meters. The highest length of silk in the cocoon was that of the race Gobio. The maximum length of silk for the races studied in 1958 ranged from 785 to 1250 meters in the first generation and the minimum length ranged from 300 to 520 meters with a mean value ranged from 599.8 to 822.6 meters in the

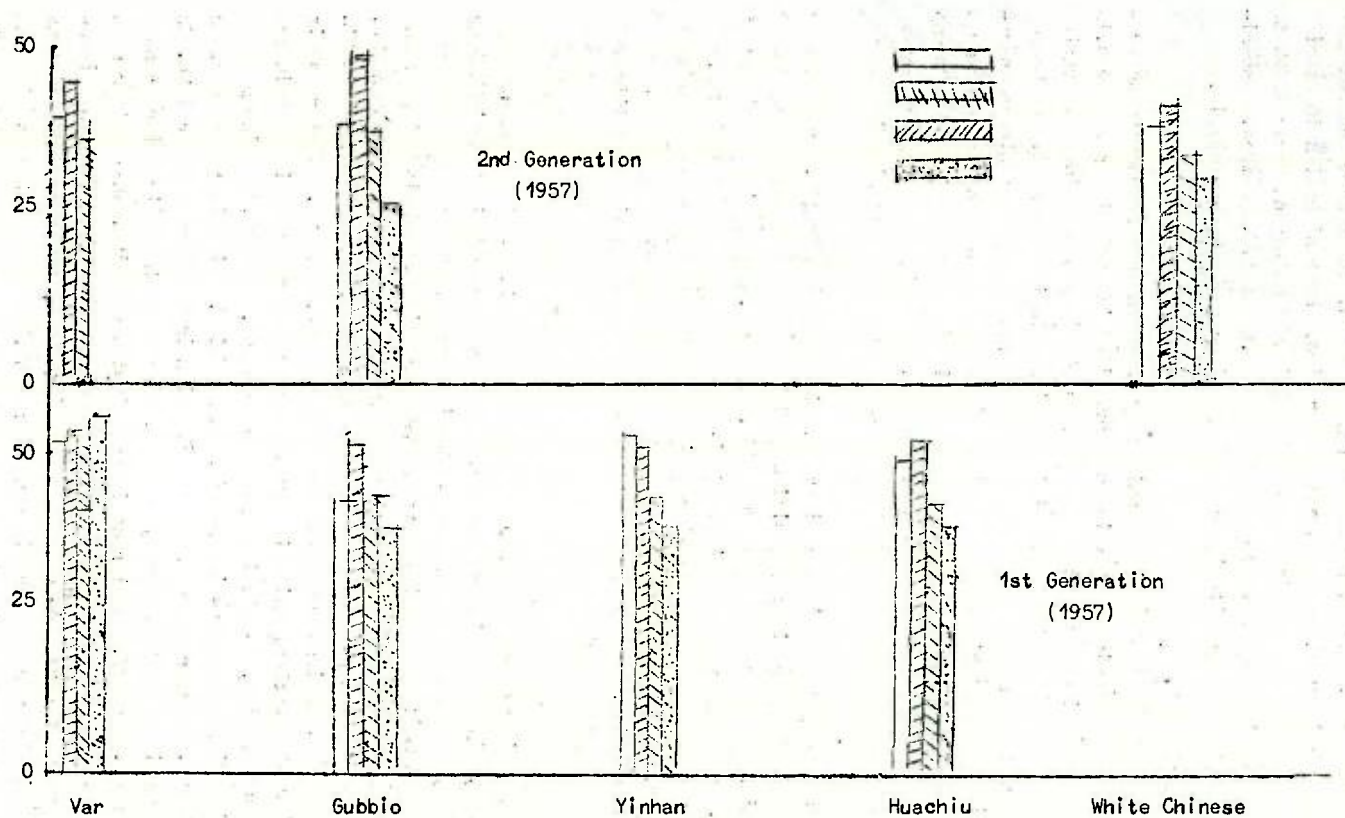


FIG. 11 - Elasticity of the silk fibre per mm/M in the different races on the dimensions 100, 300, 500 and 700 meters.

different races. The highest mean length of silk in the cocoon was that of the race Huachlu. In the second generation, the maximum length of silk ranged from 700 to 945 meters and the minimum length ranged from 140 to 415 meters with a mean value ranged from 499.2 to 676.2 meters. The highest mean length of silk in the cocoon was that of the race Gobio.

WEIGHT OF SILK.

The weight of silk fibre emitted by the worm in construction the cocoon can be determined by weighing the silk in the different races. In 1957, the maximum weight of reable silk is recorded in table varied between 172 and 240 mgms, the minimum weight varied from 40 to 70 mgms with a mean value ranged from 114.2 to 201.5 mgms in the first generation. While the maximum length of silk in the second generation ranged from 160 to 188 mgms and the minimum weight ranged from 60 to 90 mgms with a mean value ranged from 109.2 to 134.3 mgms in the different races. The heaviest mean weight of silk was that of the race Gobio in the two generations.

In 1958, the maximum weight of silk ranged from 126.2 to 336 mgms in the first generation; the minimum weight of silk ranged from 79 to 160 mgms with a mean value ranged from 149.4 to 255.4 mgms in the different races. The heaviest mean weight of silk was that of the races Yinhan. In the second generation the maximum weight of silk varied between 170 to 224 mgms, the minimum weight ranged from 46 to 98 mgms with a mean value ranged from 127.3 to 158.4 mgms. The heaviest mean weight of silk was that of the race Gobio.

TENSILE PROPERTIES.

Investigations were conducted separately on the seric filament from external, middle and internal layers of the same cocoon in the dimensions 100, 300, 500 and 700 meters by the serimeters. It was clearly observed that the tensile properties decrease from exterior to the interior of the cocoon as it is recorded in tables 15 and 16 and figs. 9, 10, 11 and 12. It is clearly observed from table 14 that the resistance of the seric fibre on the dimensions 100 meters ranged from 72.5 to 88.9 decigrams in the first generation, while it ranged from 54.1 to 63 decigrams in the second generation, and it is ranged between 64.7 to 93.3 decigrams on the dimension 300 meters in the first generation, while it ranged between 53.1 to 65.8 decigrams on the same dimension in the second generation. On the dimension of 500 meters, the resistance of the seric fibre ranged between 39.4 and 73.4 decigrams in the first generation, while it ranged between 28.9 and 45.7 decigrams in the second generation. On the dimension of 700 meters the resistance varied between 25 to 57.5 decigrams in the first generation and it ranged from 17.7 to 33 decigrams in the second generation. It is also clearly shown from table 14 that the highest resistance of silk fibres among the races reared in 1957 was that of the race Gobio, in both the first and second generation.

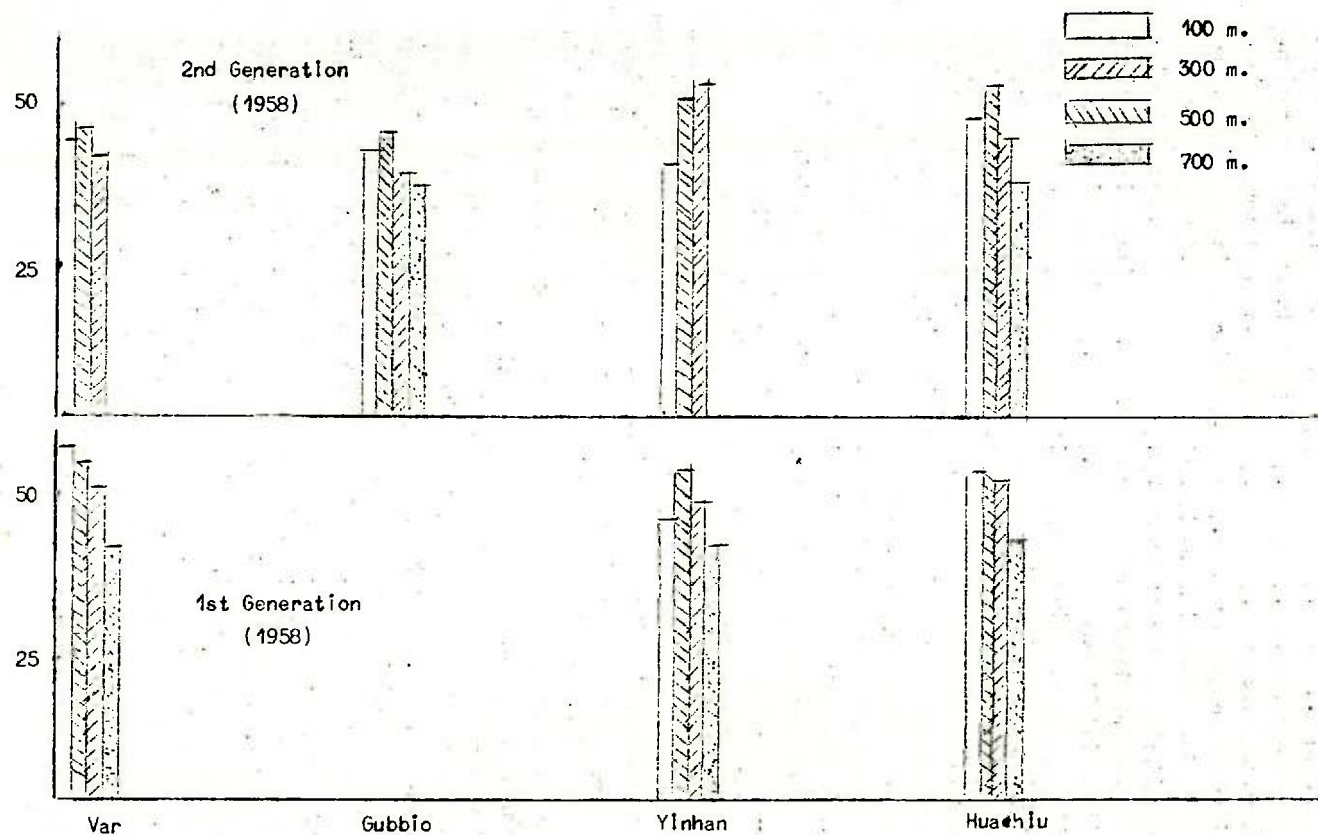


FIG. 12 - Elasticity of the silk fibre per mm/M in the different races on the dimensions 100, 300, 500 and 700 meters.

In 1958 the resistance of the silk fibre ranged between 90.3 to 114.2 decigrams in the first hundred meters in the first generation, while it ranged between 70.3 and 81.7 decigrams in the second dimension. The resistance ranged between 80.5 and 113.0 decigrams in the first generation, while it ranged between 70.3 and 90.1 decigrams in the second generation. The resistance ranged between 56.3 and 94.7 decigrams in the third dimension in the first generation and it varied between 54.1 to 70.6 on the same dimension in the second generation. On the last dimension the resistance of the seric filament ranged from 41 to 65.4 decigrams in the first generation, while it ranged between 17.7 to 47.3 decigrams in the second generation on the same dimension. It is also clearly observed that the highest resistance of the seric fibre for the races reared in 1958, was that of the race Yinhan in the first generation, while it was among the race Huachiu in the second generation. The elasticity of the seric fibre was also measured by the serimeter on the dimensions 100, 300, 500 and 700 meters. It is clearly shown from table 15 that the elasticity of the races reared in 1957 ranged between 48.4 and 55.1 mm/M in the first dimension, in the first generation while it varied between 45 and 45.9 mm/M in the second generation. In the second dimension the elasticity ranged from 52.5 to 55.9 mm/M in the first generation and it varied between 48.8 and 53 mm/M in the second generation. On the third dimension, the elasticity of the seric fibre ranged from 45.2 to 47.9 mm/M in the first generation and it ranged between 39.9 and 40.9 mm/M in the second generation. On the last dimension, the elasticity ranged from 47.9 to 60.5 mm/M in the first generation and it ranged between 34.6 to 36.7 mm/M in the second generation. The highest elasticity of the seric fibre of the races reared in 1957 was that of the race Var in the first generation, while it was in the race Gobio in the second generation.

In 1958 the elasticity of the seric fibre ranged between 46.3 and 55.3 mm/M on the first dimension, in the first generation, while it ranged between 44 and 49.6 mm/M in the second generation. On the second dimension, the elasticity ranged between 51.9 and 54.6 mm/M in the first generation and from 47 to 55.4 mm/M in the second generation. The elasticity ranged from 48.4 to 51.7 mm/M in the first generation on the dimension of 500 meters while it varied from 40.9 to 55.6 mm/M in the second generation. On the last dimension, the elasticity of the seric filament ranged between 40 and 49.6 mm/M in the first generation, and it varied between 39 and 40.6 mm/M in the second generation. It is clearly observed from table 15 that the highest elasticity of the seric filament among the races reared in 1958 was that of the race Var in the first generation, while the highest elasticity was among the two cross breeds Huachiu and Yinhan in the second generation.

TABLE 1. INCUBATION PERIOD PER DAYS.

RACES	1st GENERATION		2nd GENERATION	
	1957	1958	1957	1958
Var	9	5	7	5
Gubbio	8	9	7	5
Huachiu	7	5	-	3
Yinhan	7	5	-	3
White Chinese	-	-	-	7

TABLE 2. THE LARVAL PERIOD PER DAYS.

RACES	1st GENERATION		2nd GENERATION	
	1957	1958	1957	1958
Var	43	37	31	28
Gubbio	39	--	31	35
Yinhan	34	37	--	33
Huachiu	36	37	--	33
White Chinese	--	--	29	--

TABLE 3. PREMOULTING PERIOD PER HOURS IN THE DIFFERENT RACES.

RACES	1st MOULT		2nd MOULT		3rd MOULT		4th MOULT	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
- 1957 -								
Var	24	33	24	24	48	30	48	36
Gubbio	35	36	36	27	35	30	40	48
Yinhan	24	--	48	--	48	--	24	--
Huachiu	24	--	48	--	38	--	48	--
White Chinese	33	--	24	--	30	--	36	--
- 1958 -								
Var	24	24	48	28	48	21	48	48
Gubbio	--	36	--	27	--	30	--	48
Yinhan	43	24	48	42	60	39	48	63
Huachiu	43	24	48	42	60	39	48	63

(1) 1st generation

(2) 2nd generation

TABLE 4 : THE LARVAL INSTARS OF THE DIFFERENT RACES PER DAYS.

RACES	1st INSTAR		2nd INSTAR		3rd INSTAR		4th INSTAR		5th INSTAR	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
- 1957 -										
Var	3	5	5	4	7	4	3	5	9	8
Gubbio	7	5	5	4	6	4	6	5	9	8
Yinhan	7	-	6	-	6	-	5	-	4	-
Huachiu	7	-	7	-	6	-	5	-	4	-
White Chinese	-	5	-	4	-	2	-	5	-	6
- 1958 -										
Var	7	4	4	3	6	4	5	4	8	8
Gubbio	-	5	-	4	-	4	-	6	-	10
Yinhan	7	5	5	3	4	4	6	5	7	9
Huachiu	7	5	5	3	4	4	6	5	7	9

(1) : 1st generation. (2) : 2nd generation.

TABLE 5 : PUPAL PERIOD OF THE DIFFERENT SILKWORM RACES PER DAYS.

RACES	1st GENERATION	2nd GENERATION
Var	12	12
Gubbio	14	12
Yinhan	9	8
Huachiu	9	8
White Chinese	-	9

TABLE 6 : WEIGHT OF PUPA IN THE DIFFERENT RACES PER MGMS.

RACES	1st GENERATION			2nd GENERATION		
	Maximum	Minimum	Mean $\pm$ S.D.	Maximum	Minimum	Mean $\pm$ S.D.
- 1957 -						
Var	452	177	206.0 $\pm$ 74.6	460	58	248.6 $\pm$ 113.7
Gubbio	472	280	334.9 $\pm$ 82.9	350	90	216.9 $\pm$ 81.9
Yinhan	250	50	132.3 $\pm$ 48.8	...	..	.....
Huachiu	284	42	160.3 $\pm$ 56.8	...	..	.....
White Chinese	...	..	....	292	114	188.5 $\pm$ 54.0
- 1958 -						
Var	410	146	274.2 $\pm$ 53.3	434	261	331.6 $\pm$ 48.1
Gubbio	...	...	.....	412	247	321.6 $\pm$ 42.3
Yinhan	419	220	299.9 $\pm$ 44.0	280	132	222.1 $\pm$ 55.4
Huachiu	418	60	296.2 $\pm$ 60.5	402	144	235.7 $\pm$ 69.9

TABLE 7 : WEIGHT OF PELADE IN THE DIFFERENT RACES PER MGMS.

RACES	1st GENERATION			2nd GENERATION		
	Max.	Min.	Mean + S.D.	Max.	Min.	Mean + S.D.
- 1957 -						
Var	74	8	27.3 +15.4	150	6	26.8 + 31.6
Gubbio	60	8	29.9 +13.2	82	6	25.5 + 20.8
White Chinese	..	.	.....	30	.	9.3 + 5.9
Yinhan	48	6	17.3 +26.2	..	.	.....
Huachiu	40	4	11.4 +21.4	..	.	.....
- 1958 -						
Var	55	8	16.5 + 8.4	53	7	26.3 +15.9
Gubbio	..	.	.....	110	6	20.5 +22.6
Yinhan	47	6	19.8 +11.6	50	4	32.8 +17.4
Huachiu	52	8	20.8 +10.3	48	4	17.9 +15.7

TABLE 8 : AVERAGE LENGTH OF COCOON IN THE DIFFERENT RACES PER CMS.

- 1957 -						
Var	9.3	7.4	8.6 +0.189	8.8	5.3	8.2
Gubbio	11.1	10.0	10.5 +1.344	9.2	7.5	8.4 +0.585
White Chinese	....	....	.....	7.4	5.8	6.3 +0.163
Yinhan	8.0	6.5	7.4 +0.279	...	...	.....
Huachiu	8.3	6.2	7.5 +0.200	...	...	.....
- 1958 -						
Var	9.5	7.6	8.6 +0.118	10.0	7.5	8.6 + 0.50
Gubbio	...	...	.....	10.1	8.0	8.9 + 0.337
Yinhan	9.3	8.0	8.6 + 0.374	9.0	7.8	8.3 + 0.312
Huachiu	9.1	8.0	8.6 + 0.360	9.0	7.5	8.2 + 0.420

TABLE 9 : AVERAGE WIDTH OF COCOON IN THE DIFFERENT RACES PER CMS.

RACES		1st GENERATION			2nd GENERATION		
		Max.	Min.	Mean + S.D.	Max.	Min.	Mean + S.D.
1957	Var	6.0	4.2	5.4 + 1.94	5.5	3.8	4.7 + 0.35
	Gubbio	7.5	6.4	7.2 + 4.95	6.8	4.2	5.2 + 0.66
	White Chinese	...	...	....	5.5	3.6	4.2 + 0.20
	Yinhan	5.2	4.0	4.6 + 0.61	...	...	....
	Huachiu	5.3	4.2	4.9 + 0.27	...	...	....
1958	Var	5.8	4.4	5.2 + 0.27	5.5	4.2	4.9 + 0.39
	Gubbio	...	...	....	6.8	4.5	5.8 + 0.35
	Yinhan	6.5	5.1	5.7 + 0.32	6.0	5.1	5.2 + 0.31
	Huachiu	6.2	5.1	5.6 + 0.28	6.0	5.0	5.2 + 0.32

TABLE 10. FRESH WEIGHT OF COCOON IN THE DIFFERENT RACES PER CMS.

1957	Var	1.990	1.045	1.497 + 0.232	1.500	0.590	1.130 + 0.062
	Gubbio	2.340	1.750	1.956 + 0.217	1.700	0.700	1.290 + 0.469
	White Chinese	1.220	0.640	0.977 + 0.217	.....	.....	.....
	Huachiu	1.570	0.710	0.997 + 0.195	.....	.....	.....
1958	Var	2.165	1.031	1.524 + 0.244	1.630	0.720	1.150 + 0.530
	Gubbio	.....	.....	.....	1.630	0.700	1.170 + 0.320
	Yinhan	1.810	1.299	1.537 + 0.175	1.500	1.120	1.210 + 0.410
	Huachiu	2.045	1.116	1.495 + 0.100	1.430	1.000	1.195 + 0.315

TABLE 11 : DRY WEIGHT OF COCOON IN THE DIFFERENT RACES PER MGMS.

RACES		1st GENERATION			2nd GENERATION		
		Max.	Min.	Mean $\pm$ S.D.	Max.	Min.	Mean $\pm$ S.D.
1957	Var	616	296	466 $\pm$ 0.205	486	254	378 $\pm$ 0.056
	Gubbio	804	590	673 $\pm$ 0.148	558	354	443 $\pm$ 0.74
	White Chinese	...	...	.....	336	186	271 $\pm$ 0.038
	Yinhan	464	200	356 $\pm$ 0.202	...	...	.....
	Huashiu	540	248	357 $\pm$ 0.176	...	...	.....
1958	Var	996	396	559 $\pm$ 0.104	720	320	380 $\pm$ 0.165
	Gubbio	...	...	.....	595	335	435 $\pm$ 0.134
	Yinhan	725	310	613 $\pm$ 0.200	615	410	442 $\pm$ 0.157
	Huachiu	826	440	612 $\pm$ 0.200	622	412	440 $\pm$ 0.155

TABLE 12 : AVERAGE LENGTH OF SILK IN THE COCOON PER METERS.

1957	Var	780	245	526.2 $\pm$ 138.7	695	270	498.4 $\pm$ 109.7
	Gubbio	945	340	714.3 $\pm$ 185.0	880	300	591.6 $\pm$ 162.4
	White Chinese	...	...	.....	760	385	581.4 $\pm$ 107.1
	Yinhan	970	130	539.0 $\pm$ 163.6	...	...	.....
	Huachiu	885	250	535.0 $\pm$ 40.6	...	...	.....
1958	Var	785	300	599.8 $\pm$ 140.5	730	140	499.2 $\pm$ 191.7
	Gubbio	...	...	.....	945	285	676.2 $\pm$ 149.9
	Yinhan	1140	415	817.4 $\pm$ 137.8	700	415	570.7 $\pm$ 42.3
	Huachiu	1250	520	822.6 $\pm$ 152.6	730	140	499.2 $\pm$ 191.7

TABLE 13 : AVERAGE WEIGHT OF SILK IN THE COCOON PER MGMS.

RACES		1st GENERATION			2nd GENERATION		
		Max.	Min.	Mean $\pm$ S.D.	Max.	Min.	Mean $\pm$ S.D.
1957	Var	218	58	133.6 $\pm$ 25.4	176	50	109.2 $\pm$ 27.9
	Gubbio	240	70	201.5 $\pm$ 57.3	198	90	134.3 $\pm$ 23.4
	Yinhan	172	50	115.5 $\pm$ 33.4	....	..	.....
	Huachiu	172	40	114.2 $\pm$ 36.4	...	..	.....
	White Chinese	...	...	.....	160	64	114.3 $\pm$ 22.9
1953	Var	126	79	149.4 $\pm$ 41.4	204	48	127.3 $\pm$ 50.9
	Gubbio	...	..	.....	224	46	158.4 $\pm$ 37.4
	Yinhan	302	132	235.4 $\pm$ 41.5	170	98	140.6 $\pm$ 40.3
	Huachiu	336	160	232 $\pm$ 45.5	220	64	149.6 $\pm$ 35.6

TABLE 14 : MEAN OF RESISTANCE OF THE SERIC FILAMENT ON THE DIMENSIONS 100 , 300, 500 and 700 meters per decigrams.

RACES		1st GENERATION				2nd GENERATION			
		100	300	500	700	100	300	500	700
1957	Var	72.6	74.8	43.2	52.5	59.0	55.7	26.9	....
	Gubbio	85.3	93.9	75.4	57.5	65.3	65.6	45.7	33.0
	Yinhan	86.9	70.0	51.6	38.7	....	....	....	....
	Huachiu	76.5	64.7	39.4	25.0	....	....	....	....
	White Chinese	....	....	....	....	64.4	53.4	32.9	17.7
1953	Var	90.3	80.6	56.3	41.0	70.3	58.8	34.1	....
	Gubbio	....	....	....	....	81.4	73.0	60.3	44.2
	Yinhan	114.2	110.0	94.3	65.4	76.8	77.8	70.6	....
	Huachiu	107.2	113.0	94.7	44.9	94.7	90.4	66.7	47.3

TABLE 15 : MEAN OF ELASTICITY OF THE SERIC FILAMENT ON THE DIMENSIONS 100, 300, 500 and 700 meters per mm/M.

	RACES	1st GENERATION				2nd GENERATION			
		100	300	500	700	100	300	500	700
1957	Var	53.1	55.3	45.8	60.5	45.0	48.9	40.9	....
	Gubbio	48.4	55.9	47.2	52.4	45.1	53.1	43.4	36.7
	Yinhan	55.1	52.5	47.5	42.9	....	....	....	....
	Huachiu	52.1	53.6	47.9	43.7	....	....	....	....
	White Chinese	....	....	....	....	45.9	48.8	39.1	34.8
1958	Var	55.3	54.6	49.6	40.0	45.0	47.0	41.8	....
	Gubbio	....	....	....	....	46.5	47.4	40.9	39.0
	Yinhan	46.3	52.2	48.4	40.9	44.0	52.7	55.6	....
	Huachiu	52.4	51.9	51.7	43.2	49.6	55.4	46.7	40.6

REFERENCES.

1. CARBONI (P.) - 1952. Silk : Biology, Chemistry, and Technology.
Chapman, Londres.
2. CHAROBIM (M.) - 1925. Recherche des meilleures races de vers à soie (Bombyx mori L.).
Occitania, Paris.
3. LEGAY (J.M.) et al. - 1956. Physiologie comparée d'une race à trois mues et d'une race à quatre mues chez le ver à soie (Bombyx mori L.).
Journal of Silkworm, Vol. VIII, Alès, France.
4. LOMBARDI (L.P.) - 1956. Various observations on the hatching of the eggs of Bombyx mori L. coming from races or crosses presenting the characters of voltinism (in Italian, English summary).
Journal of Silkworm, Vol. IX (cited after Ann. Sper. Agraria, Vol. X, n°4, p. 1171).
5. LOMBARDI (L.P.) - 1951. Nouvelles races S.A. N°46 et S.A. 88.
Journal of Silkworm, Vol. II.
6. VAGO (C.) - 1951. Etude sur les causes des insuccès dans les élevages d'été du Ver à soie.
Journal of Silkworm, Vol. III.

ETUDE DE CERTAINES RACES BIVOLTINES
DE VERS A SOIE, Bombyx mori L., EN EGYPTÉ.

Résumé.

Dans cette étude, on a recherché les caractères biologiques et technologiques de différentes races bivoltines de Vers à soie (Bombyx mori L.).

Le but recherché est la sélection d'une race plus profitable, quant à la production de la soie et adaptée au climat égyptien.

Les oeufs sont jaunes après l'oviposition puis ils deviennent gris graduellement. Leur couleur varie énormément d'une race à l'autre. La période d'incubation varie de 5 à 9 jours pendant la 1ère génération, elle est de 5 à 7 jours pendant la 2ème génération.

La période larvaire dure de 34 à 43 jours pour la 1ère génération et de 28 à 33 jours pour la 2ème.

Le Ver à soie subit 3 ou 4 mues, les races que nous avons testées étaient à 4 mues.

La période de prémue varie de 24 à 48 heures dans la 1ère génération et de 24 à 63 heures dans la 2ème.

La période nymphale dure de 9 à 14 jours dans la 1ère génération et de 8 à 12 jours dans la 2ème.

Le poids moyen de la chrysalide varie de 152.3 à 334 mg pour la 1ère génération et de 198.5 à 331 mg pour la 2ème.

Le poids de la pellette varie de 11.4 à 27.3 mg pour la 1ère génération et de 9.3 à 328 mg pour la 2ème.

La couleur des cocons des croisements Yinhan et Huachiu et de la race chinois blanc est blanc argent. Les cocons de la race Var et Gubbio sont jaune pâle.

Les cocons sont sphériques, ovales ou cintrés. Leur longueur varie de 7.4 à 10.5 cms pour la 1ère génération et de 6.3 à 8.2 cm pour la 2ème.

L'épaisseur moyenne du cocon varie de 4.6 à 7.2 cm pour la 1ère génération et de 4.2 à 5.8 cm pour la 2ème.

En frais, le poids du cocon varie de 0.997 à 1.936 gm pour la 1ère génération et de 0.736 à 1.290 pour la 2ème.

La longueur de la bave varie de 535 à 822.6 mètres pour la 1ère génération.

Le poids moyen de la soie filable varie de 114.2 à 235 mg pour la 1ère génération et de 109.2 à 156.4 mg pour la 2ème.

Les propriétés dynamométriques du fil de soie décroissent des couches externes aux couches internes. Le fil le plus résistant en 1957 était celui de la race Gubbio. En 1958, c'était celui de la race Yinhan 1ère génération et la race Huachiu 2ème génération.

L'élasticité la plus grande pour les races élevées en 1957 était retrouvée dans les Var 1ère génération et Gubbio 2ème génération.

En 1958, la plus grande élasticité était celle des Var 1ère génération et des croisements Huachiu x Yinhan dans la 2ème génération.

II^{ème} CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960.

SILKWORM RACES IN INDIA.

By Mr A. T. JANAKIRAMAN (India) (*).

It is axiomatic that the progress of the silk industry in any country depends to a great extent on the availability of suitable breeds of silkworms for rearing purposes. By and large it is the inherent vitality of the silkworm race and its consequent ability to harmonise its metabolic activities with the environment which obtains, that determines the extent of stabilization of a cocoon crop. Knowing as we now do, the precise role of the environment in silkworm rearing and the innumerable ways in which the ecological factors affect the physiology of the silkworms, it is but natural to conclude that in any plan for improvement of silkworm races in a country sufficient provision must be made for the geographical differences. Needless to say in a vast country like India, this fundamental principle in silkworm breeding gains added significance.

India is aware of the tremendous progress made by other silk producing countries and notably by Japan in the evolution of suitable silkworm races. The progress that has been achieved in the other sericultural countries has been a source of great inspiration to us in India. We are at the same time aware that the ecological factors are too important to be ignored in arriving at conclusions regarding the commercial potentialities of silkworm races evolved in other countries. Under these circumstances, the obvious thing for any country to do is to evolve silkworm breeds which suit her peculiar climate as also the genius of the people engaged in cocoon production.

As stated already, the climatological differences from State to State in India are so markedly different that each sericultural State is perforce obliged to have specific silkworm races to suit her peculiar climate.

(*) Mr A. T. JANAKIRAMAN, Secretary, Central Silk Board, Meghdoot, 95-B Marine Drive, Bombay-2 (India).

The Central Silk Board of India, as the apex organization charged with the improvement of the industry as a whole in the country, is seized with this aspect of the problem and has actively sponsored many a scheme for the amelioration of existing silkworm races. The most important sericultural States in India viz. Jammu and Kashmir, West Bengal and Mysore have already established suitable hill stations for the improvement of silkworm races. A significant step of far reaching importance, affecting the welfare of the industry as a whole, is the establishment of the Central Silkworm Seed Station by the Central Silk Board of India in Kashmir. This Station was started in the year 1958 and is currently engaged in the task of evolving suitable uni and bivoltine races of silkworms for India.

INDIGENOUS SILKWORM RACES.

India has at present many indigenous silkworm races of her own. Barring one viz. : Barapolu of Bengal, all the others are multivoltines and can be reared throughout the year, both in the Gangetic plains of West Bengal and in the plateau of Mysore. While we are happy that our indigenous races of silkworms are very hardy and give stable crops even in the hot and humid months of summer, we cannot help remarking that their commercial potentialities are very limited. Shell percentage is invariably low and ranges between 10 and 13. As is well known, low shell content has a negative correlation to "lousiness character" and naturally because of the low shell content our indigenous races do not suffer much from lousiness defect. The indigenous races of India are further characterised by heavy flossiness and consequently suffer in cleanness and neatness characters. It is these shortcomings which have set a limit to possible improvement of our races by pure line selection method. The future of India sericulture industry depends on the extent to which we would succeed in evolving suitable fixed hybrids, which, while giving stable crops of cocoons, would also record an improvement in qualitative characters. No doubt the available indigenous silkworm races present a good basic material for planning the evolution of suitable silkworm races of greater commercial possibilities.

In the following we have attempted to give an idea of the available indigenous silkworm races of India. In annexure I, we have given the essential data in respect of the indigenous silkworm races of India. The following is given by way of explanation :

(1) Pure Mysore Race.

This is a multivoltine race which gives greenish yellow cocoons. The average number of green cocoons per kilogramme is 1240. The length of bave is about 411.5 meters and the denier is 1.7. Shell content varies between 11 and 12. The hardiness of the races, the absence of lousiness defect, as also its brilliant lustre are perhaps the only qualities in its favour.

This race was being reared throughout Mysore State between 1890 and 1922. In the latter year however cross-breed technique was introduced in Mysore State and ever since that time this race is being used as the fe-

male component in the F1 hybrid preparations, the male component being the Chinese or Japanese races.

Being a multivoltine, the pure Mysore race is being reared throughout the year in the State and 5 to 6 crops are raised annually. The rearing period of this race is rather long, about 30 to 35 days.

(2) Nistari.

This is the most popular multivoltine race of silkworms of West Bengal. It gives yellow cocoons weighing about 4408 per kilogramme. The length of bave however is very short i.e. about 269.8 metres and the denier also is low (1.5). The shell content is about 11 to 12 %. The hardiness of the race as also the lustre of the silk are about the only qualities in its favour. This race is reared all the year round in West Bengal State.

(3) Chotopolu.

This is also a multivoltine race of West Bengal. This produces yellow or white cocoons. The cocoons are very small and the shell percentage is also poor. This race is not so widely reared at present in West Bengal. Qualitative features are indicated in annexure I.

(4) Barapolu.

This is the only "Univoltine" indigenous silkworm race of India. The cocoons are bigger than those of the multivoltine races detailed earlier. The length of bave is about 420.6 metres and denier is 1.8. The shell content varies between 11 and 12. This race is reared in Birbhum district of West Bengal in the months of February-March. The cocoons are very flossy.

(5) Sarupat.

This is an indigenous multivoltine race of Assam State. It produces yellow, white and greenish white cocoons. The size of the cocoons is very small (1716 per kilogramme). Similarly the length of bave is 246.9 metres and denier is only 1.6. It can be reared throughout the year.

(6) Silkworm Races of Kashmir (*).

In the seventh decade of 19th century, Kashmir State did have an indigenous silkworm race of her own. In his book "Le Cocon de soie", Duseigneur Kléber, has recorded as follows :

"Kashmir cocoon resembles in form and size those obtained from silkworm races of Albania and Montenegro, but it lacks a strong shell."

(*) From "A short note on Silk industry in Kashmir" of Sericulture Department, Jammu and Kashmir State, 1955.

"Generally 16-18 kilogrammes of cocoons are required to produce 1 kilogramme of raw silk".

"Kashmir cocoon".

- (1) Form - oval elongated
- (2) One end pointed
- (3) Grain - fine
- (4) Shell - weak
- (5) Colour - white and yellow
- (6) Diameters - 540 mm x 170 mm
- (7) Gum content - 23 % - 25 %
- (8) Sarnakh - 30 % - 32 %
- (9) Rendiment - 16 to 18
- (10) Fluff - small quantity.

It would appear that this indigenous race was wiped out by the pebrine epidemic of 1878 and subsequently the State was importing seed from France and Italy.

(B) FIXED HYBRIDS.

In West Bengal State of India, considerable work has been done in the early decades of this century to evolve suitable "fixed hybrids". At present 4 of these fixed hybrids are commonly used. These 4 fixed hybrids are comparatively better than the pure indigenous races. However, the maintenance of vigour and standardization of crops have presented considerable difficulties in respect of the hybrids and a perceptible deterioration in quality has been reported. Efforts are currently being made to evolve more suitable and vigorous hybrids in West Bengal.

(1) Nistid and (2) Nismo.

Both these fixed hybrids were evolved in the early decades of this century and were fairly vigorous. They are multivoltine and spin yellow or white cocoons. The average number of cocoons per kilogramme is 968 in the case of Nistid, while in Nismo it is 946. The length of bave is 443.5 metres and 452.6 metres respectively in the case of Nistid and Nismo, while the denier is about 1.8 in both. Shell percentage is about 12 in both the races.

(3) Itan.

This is a recently fixed hybrid and is a cross between Nistari and Italian races. This is a multivoltine and produces yellow cocoons. The quality is better than that of Nistari.

(4) Iohot.

A cross between Chotopolu and Italian races. This is also a recently evolved hybrid and the quality is slightly better than that of Nistari.

(C) IMPORTED SILKWORM RACES IN INDIA.

As already stated earlier the State of Kashmir has been importing considerable quantities of silkworm seed from Europe ever since she lost her indigenous races. Besides, the other sericultural States of India viz; Mysore, Madras and West Bengal have, off and on, obtained small supplies of F1 hybrids from Japan and China for use in their programmes of producing F1 hybrids in their respective States. We could clearly categorise them according to the source as also the characteristic racial features. Almost the first work which the Central Silkworm Seed Station, Srinagar, undertook, as soon as it started functioning, was to collect the available silkworm races in India of exotic origin. Besides, the zonal hill stations in the different sericultural States have also built up considerable stocks of exotic races. The following is a fairly exhaustive list of the silkworm races currently held as "Preservation Stock" by the central and zonal stations in India :

European Races :

- 1 Adrinople white
- 2 European white
- 3 Gubbio
- 4 Alps Jaune
- 5 Gros Var yellow
- 6 Russian white
- 7 Baghdad white
- 8 Iranian white

Japanese Races :

- 1 K.N. 2
- 2 Shoka Ginrei
- 3 Banka Nikko
- 4 Taiso Hugaku
- 5 Hakuba Tenryu
- 6 J 112
- 7 J 122

Chinese Races :

- 1 New yellow
- 2 Chahkuei
- 3 Chukuei
- 4 Old yellow
- 5 Chinese 6
- 6 Chinese 7
- 7 Chinese 9
- 8 Chinese Farmers
- 9 Chinese golden
- 10 Chinese doré
- 11 Chinese yellow
- 12 C 108
- 13 C 110
- 14 C 122

Sex linked races :

- 1 Wt. N
- 2 Wt. C
- 3 Wt.-(W2)

It is a matter of gratification to us that many of our workers in the Research and the Hill Stations are currently engaged in the task of evolving suitable races of silkworms for sericultural States of India.

Needless to state that in this we have the shining example and experience of the experts of the industry in the other sericulturally advanced countries of the world, to draw upon. Useful experiments have been laid out adopting the conventional breeding techniques and we are looking forward with hope to the early solution of the problem which is currently posed before our sericultural workers in India viz. the problem of giving the sericultural farmer, a commercially suitable and qualitatively good breed of silkworm.

RACES DE VERS A SOIE EN INDE.

Résumé.

Etant donné l'importance des facteurs écologiques dans l'élevage du ver à soie, le programme d'amélioration des races en Inde a été établi en fonction des différences géographiques du pays.

Les différences climatologiques d'un Etat à l'autre sont telles que chaque Etat séricicole est contraint d'avoir des races spécifiques adaptées à son climat particulier.

Le Jammu et le Cachemire, le Bengale et le Mysore ont déjà créé des stations de grainage en montagne, dans lesquelles on fait des expériences sur l'amélioration des races. A une exception près, toutes les races indiennes de vers à soie sont multivoitines. L'avenir de l'industrie séricicole de l'Inde dépend du succès des recherches sur les hybrides.

L'auteur énumère ensuite les différentes races indigènes et il donne leurs caractéristiques; il cite avec détail, les quatre variétés hybrides réalisées et donne enfin un tableau des races de vers à soie importées en Inde.

S. No.	RACES	VOLTINISM	COLOUR OF THE COCOONS	Nº OF GREEN COCOONS PER KILOGRAMME	AVERAGE LENGTH OF BAVE IN METERS	AVERAGE DENIER	REARING SEASON	MISCELLANEOUS DISEASES
A. PURE RACES								
MYSORE								
1.	Mysore race	multivoltine	greenish yellow	1210	411.5	1.7	All the year round in Mysore State	Shell per cent is about 11 to 12
WEST BENGAL								
2.	Nistari	"	yellow	1408	269.8	1.5	All the year round in W. Bengal State	Shell per cent is about 11 to 12
3.	Chotopolu	"	yellow white	1452	256.0	1.9	At present not in much use in West Bengal State	Shell per cent is about 10 to 11
4.	Barapolu	univoltine	white	1144	420.6	1.8	in Feb.-March in Birbhum Dt. of West Bengal	Shell per cent is about 11 to 12
ASSAM								
5.	Sarupat	multivoltine	yellow and white and greenish white	1746	246.9	1.6	Can be reared throughout the year	
B. FIXED HYBRIDS								
WEST BENGAL								
1.	Nistid	"	yellow and white	968	443.5	1.8	Reared during Oct. to April	Shell per cent is about 12
2.	Nismo	"	"	946	452.6	1.8	"	"
3.	Itan	"	yellow	935	464.5	1.8	All the year round	Shell content is about 12 to 13
4.	Ichot	"	yellow and white	924	470.9	1.7	"	"

Note : (1) Material collected from CSB Bulletin n°1, 3 and 4.
 (2) 1 yard = 0.9144 metres. (3) 1 kilogramme = 2.2 lbs.

II^{ème} CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960

GENETICA ED ENDOCRINOLOGIA NEI BACHI DA SETA.
L'EREDITA' DEL TIPO METABOLICO.

Da Sr Carlo JUCCI (Italia) (*).

Il baco da seta costituisce un materiale classico per ricerche di endocrinologia: lo dimostrano gli studi di BOUNHIOL, di FUKUDA, di WILLIAMS. Ma non si può dire che l'indirizzo endocrinologico sia stato sufficientemente approfondito in modo da darci la chiave per la interpretazione delle differenze razziali e da poter essere utilizzato efficientemente per la soluzione dei problemi pratici della sericoltura.

Ci sono stati AA. giapponesi (e soprattutto MORIKAWA) - i quali - dal complesso delle loro ricerche su due gruppi di caratteri che si presentano più direttamente correlati (al lume della endocrinologia comparata degli insetti e dei risultati sperimentali ottenuti specificamente sul Bombyx) il voltinismo o numero delle generazioni nell'anno e il voltinismo o numero delle mute nello sviluppo larvale; sono assunti a considerare in una visione teorica generale la dipendenza del tipo di sviluppo dagli equilibri endocrini.

Il lavoro di MORIKAWA in questo senso è veramente notevole. Egli giunge alla conclusione che, oltrechè da fattori specifici, sia il voltinismo che il moltinismo dipendono da tanti altri fattori della costituzione genetica; e sono inoltre assai sensibili a variazioni delle condizioni estrinseche di sviluppo larvale e pupale, e ancor più dello sviluppo embrionale.

In fondo questa conclusione era già stata intravista da me sin dal 1921-1925 a conclusione dei miei studi sul voltinismo e sul treottismo.

Per il voltinismo dal complesso dei fatti raccolti e dei dati analizzati concludevo: che il polivoltinismo - e capacità di dare più di una

(*) Sr. Carlo JUCCI, Università di Pavia, Istituto di Zoologia, Palazzo Botta, Pavia (Italia).

generazione all'anno, producendo uova atte allo sviluppo ininterrotto del germe (sinechepidosi), è un carattere comune, in varia misura e in modo più o meno manifesto, a tutti i bachi da seta; che le varie razze posseggono in vario grado questa capacità, in evidente rapporto col tipo metabolico della razza; che in seno ad una stessa razza esiste larga variabilità nel carattere del voltinismo, in intima corrispondenza con la variabilità individuale metabolica; che negli incroci il comportamento ereditario del bivoltinismo - cioè la percentuale di bivoltini nelle generazioni fillali - appare diverso secondo le capacità metaboliche delle razze incrociate; - che infine quel determinato grado di tendenza al polivoltinismo che ciascuna razza, pura o incrociata, possiede, si rivela non con un determinato e costante carattere - di avere due o più generazioni all'anno - ma con una determinata capacità di reazione alle condizioni e estrinseche di sviluppo.

Così il bivoltinismo ed il suo comportamento ereditario restano inquadrate, come caso particolare, nel problema generale dell'eredità del tipo metabolico.

Anzi, avevo dato più importanza alla messa in evidenza di questa determinazione poligenica che alla individuazione dei singoli geni. Ma intanto Anna FOA - la Direttrice dell'Istituto di Bachicoltura in Portici - scopriva per il voltinismo i fattori legati al sesso.

Quanto al treottismo - pur confermando i risultati sulla mendelianità del fattore principale - dall'incrocio di diverse razze quartine con una stessa razza a tre mute intravidi la esistenza di fattori modificatori, poi studiati con tanta esattezza da OGURA.

Parlavo così della eredità del tipo metabolico, avendo incominciato le mie ricerche sulla indagine comparata della curva di sviluppo in razze univoltine e bivoltine, a 3 e a 4 mute. Ero passato ai bachi dopo avere studiate le Termiti, aver scoperto nelle ghiandole tentoriali il primo esempio di ghiandole endocrine del tipo protoracico e avere interpretato la differenziazione delle caste come operata da fattori metabolici facenti leva sul sistema endocrino; e mi avviavo a portare la stessa linea di lavoro nello studio della biologia delle razze di bachi da seta.

Ma una folla di altri problemi e specialmente la investigazione fisiogenetica - cioè abbinando alla ricerca genetica la biochimica come nel metabolismo dei pigmenti e dell'azoto - trascinavano me e la Manunta e poi altri collaboratori lontano da quella strada.

Oggi - dopo così brillanti sviluppi della endocrinologia generale e comparata nel campo degli Insetti, e così grande approfondimento delle ricerche fisiogenetiche, accanto a quelle di genetica formale sui bachi da seta - si presenta necessario correlare le due direzioni di lavoro cercando di mettere in luce l'influenza degli equilibri endocrini nella determinazione, da una parte dei tipi metabolici non dovuti a solo effet -

to di concatenazione genica, ma di integrazione, attraverso il sistema endocrino, in quadri pleiotropici e razziali; d'altra parte delle reazioni fenotipiche suscetibili col variare delle condizioni estrinseche.

Questi studi presentano non soltanto un altro interesse teorico ma una grande importanza pratica. Basti accennare che la selezione assai spinta, verso le più alte possibilità di secrezione serica, inevitabilmente porta una sorta di sbilancio organico o per lo meno di delicatezza che si può superare solo con un raffinamento e squisita specificità di adattamento delle condizioni estrinseche; di incubazione (temp., umidità, luce) e di sviluppo larvale (condizione termiche, igrometriche, alimentari, igieniche, etc...).

Solo l'individuazione di condizioni ottimali di sviluppo embrionale, larvale e pupale può arrivare a compensare la resistenza minore, la delicatezza o, come si suol dire, l'ingentilimento prodotto dalla selezione: e non sufficientemente compensato neanche della utilizzazione sapiente dei fenomeni di eterosi nella adozione degli ibridi semplici o doppi.

Da questo deriva la grande importanza anche pratica - oltrechè tecnica - dello sforzo di individuare ed analizzare l'importanza del fattore endocrino in tutte le manifestazioni fenotipiche nelle quali si traduce la interazione tra le potenzialità ereditarie (le caratteristiche genotipiche) e le condizioni ambientali.

Insomma, il concetto è che noi dobbiamo sempre cercare - nello studio di ogni processo morfologico e fisiologico - di individuare la componente endocrina che agisce da leva sulla quale fanno presa sia i fattori intrinseci che gli estrinseci per la determinazione delle caratteristiche fenotipiche.

Ovunque lo studio attento dei processi biologici comincia a mettere in evidenza fattori ormonici: anche nella induzione per shock termici di poliedrosi nucleari e citoplasmatiche (ARUGA).

E' probabile che una indagine profonda delle differenze razziali di suscettibilità o resistenza ad altri agenti patogeni - come la Botrite del calcino, il Nosema della pebrina, e i Batteri della flaccidezza mostrerebbero anch'essi dei fattori ormonali che intervengono (per es. condizionando la formazione di anticorpi o l'intensità di processi cellulari per es. di fagocitosi).

Anche nel campo della determinazione di caratteristiche biochimiche comincia a intravedersi la importanza del fattore endocrino. Basti pensare alla possibilità che le pterine entrino (come suppone l'Helias) nell'ambito diretto del metabolismo dei corpora cardiaca; al fatto che il metabolismo delle pterine ha stretti rapporti con quello delle purine e delle melanine; alla probabilità che il metabolismo delle purine sia anch'esso efficientemente regolato da elementi della costellazione endocrina: come dimostra l'altro la influenza delle ablazione dei corpora

cardiaca sull'accumulo di urati del corpo adiposo delle blatte, secondo EODENSTEIN).

Non meno concreta è la probabilità che lo stato endocrino influenzi potentemente il passaggio di sostanze dal sangue materno alle uova determinando le caratteristiche dello sviluppo embrionale e le capacità di reazione a condizioni di incubazione e a trattamenti attivanti nel bivoltinismo artificiale e nella partenogenesi sperimentale (YOSHITAKE, 1954, 1955).

Va anche tenuta presente la possibilità che lo stato endocrino influenzi anche le proprietà di permeabilità dei tessuti e quindi anche per es., di determinazione di colore del bozzolo e magari dei tegumenti.

Noi che all'Istituto Spallanzani da decenni lavoriamo sulla fisiogenetica comparata della razze di Bombyx, rivolgiamo oggi in modo particolare la nostra attenzione sperimentale alle possibilità di una endocrinologia comparata delle razze di bachi da seta, che ci proponiamo di fondare sulla esplorazione sistematica degli effetti:

1) di ablazione o trapianto di corpora allata e ghiandole protoraciche da una parte, di cervello e gangli dall'altra: associando le due sorta di interventi per meglio analizzare le interazioni, attraverso le cellule neurocrine dei due grandi sistemi integratori: il nervoso e l'endocrino.

2) Di variazioni delle condizioni ambientali (temperatura, luce, umidità e alimentazione) agenti sullo sviluppo embrionale, larvale, crisalidale di bachi normali come anche di operati (secondo il programma 1) o di malati.

Ci proponiamo anche di portare la nostra osservazione e sperimentazione endocrinologica - una volta chiarite le idee con la comparazione di razze pure a tre o quattro mute, univoltine e polivoltine, a pelle gialla e a pelle trasparente e, più generalmente, a costituzione genetica ben definita e a tipo metabolico ben definito - su ibridi di prima generazione; cercando di definire che parte la componente endocrina gioca nella determinazione degli effetti eterozigoti; ed estendendo eventualmente la ricerca anche a successive generazioni per investigare la correlazione tra divergenze della discendenza per segregazione mendeliana di caratteristiche morfologiche e fisiologiche, e divergenza di aspetti endocrini.

Ci prospettiamo infine l'interesse di una endocrinologia comparata dei lepidotteri serigeni: fondata anzitutto sul confronto tra Bombyx e Theophila (oltre la T. mandarina, altre come la religiosa dell'Assam) e poi anche altri Bombicidi e Saturnidi: cercando di scovare quanto nelle differenze specifiche dipenda da differenze profonde di produzione ormonale da parte dei vari organi endocrini e quanto da differenze di meccanismo di liberazione (release) e messa in circolo degli ormoni stessi, in rapporto adattativo alla ecologia e alla etologia (o più precisamente

agli stimoli determinanti le preferenze ecologiche e la peculiarità etologiche) delle insetto serigeno.

(*) Il concetto che in fondo anche la eterosi sia dipendente da variazioni dell'equilibrio endocrino - in forme, s'intende, che come gli insetti e invertebrati hanno un sistema elaborato e complesso di integrazione ormonale - se certo è interessante, però non potrebbe prendere forma concreta se non in base a ricerche che seguano e cerchino di valutare quantitativamente il bilancio endocrino negli individui ibridi della F1 rispetto alle forme parentali.

Per es. nei bachi da seta misurare la curva di sviluppo dei corpora allata di razze come giallo indigeno e Bianco cinese in confronto agli ibridi F1 reciproci (per es. ♀ TG ♂ AP e ♀ AP ♂ TG) potrà riuscire assai interessante. Però per i corpora allata - e se è possibile per le ghiandole protoraciche; e magari anche per le cellule neurocrine del cervello e del sottoesofageo - bisognerebbe che la curva potesse essere tracciata dettagliatamente: cioè non solo prendendo punti nodali quali dimensioni e stato di funzionalità (a mezzo di indagini istochimiche) ghiandolare alla nascita e in ogni sonno e muta, ma anche con dettaglio durante le varie fasi dell'ingresso in sonno sino a muta avanzata.

Chissà che la esplorazione del tipo endocrino delle razze non ci permetta di prevedere abbastanza bene le capacità combinatoria delle razze stesse nella confezione di incroci semplici (a due vie) o dei doppi (a quattro vie).

BIBLIOGRAFIA.

- ARUGA (H.), ARAI (N.) - 1959. Studies on the induction of polyhedroses by the low temperature treatment in the silkworm, Bombyx mori.
Jour. of Sericultural Science of Japan, Vol. XXVIII, n°6.
- ARUGA (H.), KANAI (E.) and ISRANGKUL NA AYUDHYA (A.) - 1959. On the relationship between physiological conditions of larvae and the induction of polyhedroses in the silkworm, Bombyx mori.
Jour. of Sericultural Science of Japan, Vol. XXVIII, n°6.
- BODENSTEIN (D.) - 1953. Studies on the humoral mechanism in growth and metamorphosis of the cockroach. Pèriplaneta americana. II. The function of the prothoracic gland and the corpus cardiacum.
J. Exp. Zool., 123, 413-33.
- JUCCI (C.) - 1922. Sulla curva di sviluppo del baco da seta.
Boll. Lab. Zool. Gen. e Agr. Portici, Vol. XVI, p. 59-136.
- JUCCI (C.) - 1924. Sull'eredità del tipo metabolico nei bachi da seta. II voltinismo.
Annali R. Sc. Sup. Agr. Portici, Vol. XIX, Boll. Lab. Zool. Gen. e Agr., Portici, Vol. XVII, p. 187-318.
- KOGURE (M.) - 1933. The influence of light and temperature on certain characters of the silkworm, Bombyx mori.
Jour. of the Depart. of Agriculture, Kyushu Imperial Univ., Vol. 4, n°1.
- YOSHITAKE (N.) - 1954. Biochemical studies on the voltinism in Lepidoptera. I. On the function of the hormones determining voltinism with special reference to the pigment formation in the sarcosa of the silkworm egg.
Jour. of Sericultural Science of Japan, Vol. XXIII, n°2.
- YOSHITAKE (N.) - 1955. Biochemical studies on the voltinism in Lepidoptera. IV. On the responses of staining in the non-hibernating and hibernating eggs of the silkworm, Bombyx mori L.
Jour. of Sericultural Science of Japan, Vol. XXIV, n°2.
-

11^{ème} CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960

PREPARAZIONE DI IBRIDI CON RAZZE ITALIANE E CINESI.
RISULTATI.

NOTA I^a (Preliminare).

Da Sra. LOMBARDI P. L. (Italia) (*).

Nell'industria bacologica italiana era in uso l'impiego, per l'allevamento del baco, di razze pure o di incroci, tra due razze, ed erano usate razze indigene sferiche e cinturate gialle e razze chinesi oro e bianche a bozzolo sferico o ovale.

Queste razze con i loro rispettivi incroci vivono egregiamente in Italia, essi non hanno bisogno di speciali cure, sono robustissimi ma non presentano in modo esaltato il carattere "ricchezza in seta". Infatti la lunghezza dipanabile della bava serica di ogni singolo bozzolo presenta una media di m. 800-850.

Da oltre un decennio si cominciò ad avvertire la necessità di avere razze robuste ma più ricche di corteccia serica. Anteriormente a tale epoca furono compiuti studi per la creazione di nuove razze, per la fissazione di specifici caratteri, uniformità di colore, di forma, di finezza di bava o di bava tonda. Con la pratica successiva degli incroci, per una maggiore ricchezza in seta, non si è riusciti ad ottenere che un modesto miglioramento in molte razze ed un apprezzabile miglioramento in poche razze siano esse allo stato di pure sia di incrocio a due o quattro razze.

Qualunque razza di Bombyx mori che viene importata e allevata in Italia trova l'ambiente adatto al suo sviluppo ma purtroppo se da un lato acquista maggiore robustezza e quindi maggiore sviluppo della larva e della successiva farfalla perde lentamente la sua prerogativa per il carattere "ricchezza in seta". Nelle razze importate a "ricchezza in seta" man mano diminuisce la secrezione serica, così come nelle razze po-

(*) Mlle LOMBARDI Porzia Lorenza, Directrice de la Station Séréricole Expérimentale, Padoue (Italie).

l'ivoltine importate il voltinismo lentamente scomparso, la larva si ingrossa, aumenta anche il peso della corseccia serica che però non supera mai il 30 per cento in più di quello che era l'originale peso della corseccia del polivoltino.

Bastano due esempi a darci un'idea di quanto di frequente si verificò. Nel 1934 furono importate dalla Cina un considerevole numero di razze bene selezionate per lunghezza di bava, qualcuna di esse toccava la punta media di m. 1600-1700, dopo alcuni anni questo carattere è andato perduto e tutte quelle razze presentano una lunghezza di filo uguale alle nostre comuni razze, cioè m. 800-850.

Si è tentata una successiva selezione ma eccetto due o tre razze che si avvicinano ai 900-950 metri, le altre sino ad oggi sono rimaste insensibili alla selezione iniziata sino dal 1939. Si è cercato impiegarle negli incroci tra due o quattro razze, usando nella preparazione dell'incrocio qualche razza a bava lunga, ma eccettuati pochi casi, esse non hanno dato risultati soddisfacenti.

Una polivoltina indiana, importata dall'Assam nel 1952 per 18 mesi non ha presentato mai uova in diapausa, di colpo successivamente divenne trivoltina e oggi è una bivoltina solo parzialmente.

Nel 1947 furono iniziate una serie di esperienze allo scopo di poter ottenere qualche incrocio che presentasse una maggiore ricchezza in seta e tutti i caratteri organolettici della seta italiana. Fu usato un considerevole numero di razze; razze già in precedenza selezionate per alcuni caratteri e quindi da potersi considerare industrialmente pure. Queste razze erano principalmente italiane, cinesi e qualche vecchia razza giapponese importata nel 1918-22 ed erano monovoltine, bivoltine, polivoltine.

Da un'accurata selezione delle razze pure, usate successivamente per formare il primo incrocio che doveva servire per il successivo incrocio a quattro razze, si ottennero nei discendenti individui che superavano i m. 1000 di lunghezza di bava.

Gli individui più pesanti e a bava più lunga formarono il ceppo di una accurata selezione. Si sono ottenute razze a bava lunga, già data all'industria la gialla "Tg" che fa parte delle razze "ceppo" e la "AP" oro, anch'essa del "ceppo". La "Tg" è una razza italiana a bozzolo giallo carneo, anellato, la "AP" è di origine cinese a bozzolo pro, acclimatata in Italia da oltre 50 anni. Inoltre altre razze gialle sferiche e cinturate sono state selezionate per il carattere "ricchezza in seta" e sono la "Ascoli", la "Varo", la "LT", la "Minano" (questa ultima di origine spagnola) e la R2 sferico-ovale.

Tutte queste razze, pur variando da anno ad anno il loro carattere perché su di esso influiscono le condizioni di ambiente e di alimento,

raggiungono in media l m. 1000 e oltre per circa il 70-75 per cento degli individui. E' difficile superare tale percentuale. Abbiamo punte di 1300-1400 ma i rimanenti 30-25 individui si filano male, producono poca seta e perciò la media non è elevata riguardo alla ricchezza in seta.

Se consideriamo invece la ricchezza in seta in base al rapporto tra peso della crisalide e della cortuccia serica notiamo una maggiore ricchezza in seta. Ciò è dovuto al fatto che di sovente si constata nella filatura che è molto alta la percentuale di strusa. Resta da indagare, con una serie di esperienze in corso, questo difetto da che cosa è causato: dall'essiccazione non adeguata a quel tipo di incrocio, da un mancato macero, da una eventuale differenza di temperatura delle acque di filatura, dal tipo di acqua usato per la filatura?

Queste razze ora descritte non sono passate nell'industria ma fanno parte del patrimonio nazionale ora custodito dalla Stazione di Padova, eccettuate la "Tg" e la "AP" perché oggi in Italia è diffuso l'ibrido giapponese per la sua intrinseca qualità di baco ricco di seta.

E' sempre prudente però, anche se oggi si sfruttano gli incroci giapponesi che gli sperimentatori cerchino di interessarsi allo studio di altre razze già conosciute per il loro comportamento, robustezza e prodotto seta, per potere eventualmente riuscire ad aumentare la secrezione serigena.

Una serie di razze, incroci a due, tre e quattro razze, furono presi in esame e dopo una prova ripetuta per tre anni, se i risultati non erano soddisfacenti, venivano eliminati e altri incroci subentravano a far parte dei gruppi in esperimento. I tipi che presentavano requisiti migliori venivano oggi anno ripetuti ed oggi dopo un lungo periodo di prove non solo di allevamento e di comportamento circa la robustezza e la durata del ciclo larvale, ma specialmente per quanto si riferisce alla ricchezza in seta, allo svolgimento, al titolo della bava e ai caratteri più salienti e pregiati del filo serico, possiamo presentare per il gruppo bianco tre incroci a due razze, uno a tre e tre a quattro razze.

Alla tabella n. 1 acclusa al lavoro sono segnati i dati più importanti. I bozzoli non vengono scelti ma presi dal monte (T.Q.). Alcune razze sono di nuova creazione derivanti da poche o molte razze, portano ancora per distinzione un numero perché non sono state classificate.

Alla tabella n. 2 i dati di tipi di incroci colorati. Questi sono sei; due a due razze, quattro a quattro razze. Le razze impiegate per questi due gruppi sono tra le migliori oggi in possesso della Stazione ed alcune di esse hanno subito una rigorosa selezione per oltre un ventennio (Tg - LT - Gransasso - AP - 402).

Considerando i risultati e le osservazioni fatte dal Direttore della Filanda possiamo dire che siamo sulla buona strada, che qualche incrocio-

sia bianco, sia colorato ha una rendita ottima o buona, tra i bianchi notiamo due tipi che hanno un impiego di 2,50 - 2,53, tra un impiego di 3 o quasi, gli altri tre, 3,12-3,20. Tutti questi lotti hanno dato una percentuale di strusa alquanto elevata. Es. il lotto con una rendita di 2,50 ha dato il 26;57 di strusa; questa strusa è seta che non è stata recuperata come filo filabile per ragioni non ancora note. Se si riuscisse ad ottenere almeno il 50 per cento in meno di strusa la rendita sarebbe non di 2,50 ma forse di 2,25-2,30. E ciò vale anche per gli altri lotti.

Vi sono caratteristiche apprezzabili che invitano a provare e riprovare per migliorare i risultati.

Il lotto segnato al n. 4, della tabella n. 1, eccetto il titolo molto tondo, ha seta bianca, lucente pastosa e questo è un incrocio a due razze, che dà una rendita di 3 ma una percentuale di strusa elevata 33,33 che trasformata in seta (50 %) filabile si avvicinerebbe al 2,60-2,70. Il lotto segnato al n. 7, incrocio a quattro razze che dà una rendita di 3,12 una percentuale di strusa 24,48 viene descritto "bava fine, grande elasticità e tenacità, seta bianca, lucida, molto pastosa e vellutata".

Dai risultati dei colorati, notiamo che la rendita varia negli incroci a due razze da 3,09 a 3,16 e nei due casi la percentuale di strusa è superiore a 30. Nei quattro tipi a quattro razze si conferma quanto riferito per gli altri incroci. Rendita 3,083-3,129-3,260-3,40 e con un per cento di strusa che varia dal 14,25 al 21,49.

Con questa rapida rassegna è dimostrato che tipi di incroci bianchi e gialli, a due o più razze si sono ottenuti con razze per la maggior parte indigene di vecchia data e di nuova creazione. Pur non presentando esaltato il carattere "ricchezza in seta" come le razze e meglio gli incroci multipli giapponesi hanno una corteccia serica spessa che bene determina in tutti questi casi che esiste il carattere accentuato ed anche alquanto esaltato di "ricchezza in seta". Ma parte di questa corteccia non si fila e si trasforma in strusa. Questo è il punto che oggi è preso in esame e che andrà studiato e seguito in collaborazione con un serio e cosciente direttore di filanda. Questo caso si verifica in tutti i lotti segnalati perciò dovrà esserci un difetto o nella essiccazione o nella filatura (acqua, macero, temperatura, ecc.). Sono in corso installazioni di essiccatoi speciali e filandine per poter riuscire ad eliminare tale inconveniente.

La ricerca è fatta così, è ricca di sorprese spesso più negative che positive. Molti mezzi, uomini, sarebbero necessari per conseguire lavori così lunghi, pazienti, e delicati, ma questi spesso, per non dire quasi sempre mancano. Aspettare e rimediare con mezzi di fortuna nuova.

Nel caso presente speriamo, con la buona volontà e con la pazienza dei cortosini, raggiungere lo scopo e cioè mettere a disposizione dell'industria italiana, al più presto, incroci vari a due e più razze, bianchi e colorati che oltre a tutti gli eccellenti requisiti caratteristici

della seta italiana possano aggiungere anche quello, che oggi é l'unico e da tutti ricercato, della "ricchezza in seta".

PREPARATION DES HYBRIDES AVEC DES RACES ITALIENNES ET CHINOISES. RESULTATS
NOTE PRELIMINAIRE.

Résumé.

Dans cet ouvrage on donne un aperçu sur quelques caractéristiques des races indigènes et sur celles qui ont été importées et qui se sont déjà acclimatées. Les indigènes ne présentent pas distinctement prononcé le caractère richesse en soie; seulement un nombre déterminé d'entre elles, avec une sélection soignée qui a duré plus d'une vingtaine d'années, présentent une plus grande richesse en soie, mais ce caractère ne se trouve pas exalté comme celui des hybrides japonais. En Italie, vivent fort bien toutes les races de Bombyx mori; elles deviennent robustes, les larves et les papillons s'engraissent aux dépens des glandes séricigènes. Les races importées après quelques années perdent souvent une partie de la matière séricigène exactement comme les polyvoltines perdent entièrement ou en partie leur voltinisme. Dans ce cas toutefois, en perdant le caractère voltinisme, la grosseur du cocon augmente c'est à dire que son poids excède d'environ 20-30 % celui de l'original. Des races monovoltines importées de Chine en 1934 avec une longueur de bave de 1600-1700 mètres présentent aujourd'hui 800-900 mètres et seulement en quelques cas, avec une sélection successive, on remarque 900-950 mètres de bave à dévider. Une polyvoltine de l'Assam importée en 1952 est aujourd'hui une bivoltine partielle.

En 1947, commença une série d'expériences en pratiquant des croisements à deux, trois ou quatre races en employant des races colorées et des races blanches sélectionnées et ayant une certaine richesse en soie. La sélection des susdites races pures se basait sur le poids de la coque et sur la longueur de la bave.

Plusieurs croisements ont été essayés, beaucoup ont été éliminés et quelques uns présentent, outre la robustesse de la larve et la vitalité de l'adulte des caractères appréciables du fil de soie, et une richesse en soie non négligeable.

Nous avons aujourd'hui pour le groupe blanc sept types : trois croisements à deux races, un à trois et trois à quatre races.

Pour le groupe coloré six types : deux croisements à deux races et quatre à quatre races.

Dans les tableaux ci-joints, sont reportées les données obtenues par la filature qui a accompli les essais et quelques appréciations du Directeur de ladite filature.

Dans les blancs il y a des cas avec une rentrée à la bassine de 2,50 et un seul cas maximum 3,20. Nous remarquons un pourcentage de rébut dans certains types plutôt élevé 36,15, 33,33 et nous remarquons aussi que quelques uns d'entre eux présentent un développement et un produit excellent, une soie molleuse et une bave fine.

Pour les lots colorés le rendement va de 5,09 à 5,48 ; dans ces derniers également le pourcentage de rébut est élevé de 14,23 à 36,36.

Ce pourcentage de rébut élevé au détriment du rendement, nous contraint d'en examiner les causes et d'essayer de le réduire de 50 %. Si nous réussissons à éliminer même en partie cet inconvénient, nous aurons des croisements à deux ou plusieurs races qui, en plus des nombreux mérites de nos soies, présenteraient le caractère "richesse en soie" exigé aujourd'hui par tout le monde.

PREPARATION OF HYBRIDS WITH ITALIAN AND CHINESE RACES. RESULTS.

Preliminary Note.

Summary.

This paper gives a glimpse on some characteristics of the indigenous and imported races. The indigenous races do not show a very important silk richness, a small number of them only, after twenty years selection, have a more important silk richness, however this characteristic is not too important as in the Japanese hybrids.

In Italy all the races of Bombyx mori well develop, they become strong, larvae and moths grow fat at the expense of the silk glands. After some years, the imported races loose part of their sericoigenous matter and the polyvoltine races loose their voltinism. However in this case, as the races loose their voltinism the size of the cocoon increases, that is to say its weight exceeds by 20-30 % the weight of the original cocoon. In the monovoltine races imported from China in 1934, the bave was 1,600-1,700 meters long, now it is 800-850 meters, except for some of them which measure, after successive selection 900-950 meters. A polyvoltine race imported from Assam in 1952 is actually partially bivoltine.

In 1947, series of experiments were started : two, three or four coloured and white races, previously selected and rich in silk, were cross-bred. The selection of this races was based on the weight of the husk and the length of the bave.

Several cross-breedings were tried, many were eliminated, some show besides the vigour of the larva and the vitality of the adult, noticeable qualities of the silk yarn and a significant silk richness.

To-day we have seven types for the white group, three cross-breedings with two races, one with three and three with four races.

For the coloured group we have six types : two cross-breedings with two races and four with four races.

Among the white races some have a silk yield of 2.5, one has a maximum yield of 3.20. We notice in some type a rather high waste percentage : 36.15-33.33 % and we notice that some of them have an excellent development; they give a soft silk and a thin bave.

As for the coloured lots the silk yield varies from 3.09 to 3.48 in these lots the waste percentage is high from 14.23 to 36.36.

This high waste percentage which decreases the silk yield needs being examined in its causes. It must be reduced by 50 %. If we succeed in eliminating even part of this inconvenient , we shall obtain cross-breedings with two of several races which , beyond the many qualities of our silks, will have the "silk richness" characteristics required to-day all over the world.

TABELLA N.1 - INCROCI BIANCHI A DUE, TRE, QUATTRO RAZZE. Risultati filatura bozzoli 1959.

N. ordi- ne	I N C R O C I O	T.Q. (2) bozzoli (g)	rendita	strusa (%)	galletame (%)	titolo	osservazioni del direttore della filanda
1	71 x 140 M (1)	360	3,--	33,33	--	24,25	Svolgimento ottimo - bava molto tonda - seta bianca - lucente, pastosa.
2	73 x 293 (1)	380	2,53	20,--	6,06	19,75	Svolgimento buono - rendita ottima - bava fine
3	750 Z x 14 biv. (1)	1050	3,20	36,15	1,25	17,50	Svolgimento ottimo - forte produzione - bava fine
4	71 x 8368 x Novi (1)	910	3,--	25,92	----	22,50	Svolgimento regolare - rendita buona - bava tonda
5	403 x 380 x 280 x 408	350	2,5	28,57	----	22,50	Svolgimento buono - rendita ottima - bava tonda
6	chin.b.l.x351Mx Awoijku x 14 biv.	3790	3,03	27,86	5,76	21,--	Svolgimento buono - rendita buona - bava regolare
7	8869 x 750 M x 628 M x 190M (1)	3780	3,12	24,48	5,45	20,--	Svolgimento buono - bava fine - grande elasticità e tenacità - seta bianca candida - molto pastosa e vellutata

(1) Le razze segnate con i nn. 71, 73, 293, 750 Z, 8868, 8889 sono nuove razze non ancora classificate.

(2) "TQ" "Tale quale"

TABELLA N.2 - INCROCI COLORATI A DUE E QUATTRO RAZZE. RISULTATI FILATURA 1959.

N. ordine	I N C R O C I O	T.Q. bozzoli (g)	rendita	strusa (%)	gallettame (%)	titolo	osservazioni del direttore della filanda
1	402 M x LT	340	3,09	36,36	---	22.-	Svolgimento ottimo - forte produzione - ottima coesione - bava tonda
2	Minano x Tg	380	3,16	33,33	---	19,50	Svolgimento ottimo - rendita buona - bava regolare
3	C60 x Tg x Tg x AP	3590	3,48	14,25	1,33	20,22	Svolgimento buono - ottima produzione - forte elasticità - bava regolare
4	Majella x R2 x Tg x Minano	3470	3,088	18,62	1,78	20.-	Svolgimento ottimo - buona elasticità - bava fine
5	S.A.n.1 x Tg x R2 x Gran sasso	3400	3,260	21,19	1,08	20,75	Svolgimento ottimo - rendita ottima - bava regolare
6	Tg x AP x 402M x Tg	3520	3,129	17,60	0,47	21.-	Svolgimento buono - rendita ottima - produzione buona - bava regolare

11ème CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960

STUDIES ON RADIATION MUTAGENESIS IN THE SILKWORM (1).

communicated by Mr Yataro TAZIMA (Japan) (*).

For quantitative assessment of the genetic consequences of radiation effect on living animals, it is of cardinal importance to know the exact magnitude of radiation-induced mutation rates in the examined organisms. Many investigations have been done to accumulate those data with utmost care.

However, the recent progress of radiation genetics in *Drosophila*, and mouse has demonstrated that there are marked variations in induced mutation rates between the developmental stages of spermatogenic cells. These studies have been carried out in the males of *Drosophila* and mouse, whose germ-cells are heterogeneous regarding the developmental stages. The work can be more exactly carried out in the silkworm, in which most of the germ-cells develop simultaneously in the gonad.

Another purpose of this study lies in sericultural interest. It seems highly probable, as was suggested by my previous investigations that induction of mutations of economical value might successfully be carried out in the silkworm with radiation. But I felt keenly the lack of our knowledge in radiation biology in this insect.

From these reasons we have been carrying out fundamental investigations on radiation mutagenesis in the silkworm. The results so far obtained are presented as follows in abstract.

The following article will appear in the coming issue of the Annual report of the National Institute of Genetics (Japan), No 10, 1959.

(*) Yataro TAZIMA, National Institute of Genetics, Misima, Japan.

(1) This study covering six papers (VII to XII) completes a study already issued (I to VI) under the same title in the Annual Report of the National Institute of Genetics. (cf. bibliographical addendum).

VII. NATURE OF RADIATION-INDUCED MUTATIONS DETECTED BY THE SPECIFIC LOCI METHOD IN SILKWORM.

By Mr Yataro TAZIMA and Mr Kimiharu ONIMARU.

According to the specific loci method detected mutants might be represented several kinds of mutations, i.e., gene mutations, small deficiencies and gross structural changes. It is therefore essential for the calculation of the exact mutation rate to examine what kind of mutation was obtained under a given treatment.

In silkworm this method was employed in a number of irradiation experiments but the nature of the recovered mutants has never been thoroughly examined. Hence the present experiment was undertaken. The result seems to indicate that mutation reaction might differ according to the locus tested. When +ch locus was tested the incidence of ch mutants in F₁ seemed to be caused by deficiency at that locus. Whereas, the results obtained for +^{pe} and +^{re} were not explained satisfactorily by the same mechanism and could be understood only by assuming gene mutation.

The apparently different results in the two cases could be explained by assuming that most of mutations detected at the three specific loci were gene mutations from dominants to recessives and that the type of mutation response is determined by the time relation between the manifestation of mutant genes and the stage of embryos dying due to associated lethals.

Thus it seems likely that the principal event of mutation caused by radiation is gene mutation and whether it is associated with chromosomal deficiency or not is merely incidental.

VIII. X-RAY INDUCED DOMINANT LETHALS FROM IRRADIATION OF DIFFERENT STAGES OF OÖGENESIS IN SILKWORM

By Mr Yataro TAZIMA and Mr Kimiharu ONIMARU.

By irradiating successive stages of oögenesis, two radiation sensitive stages were revealed in silkworm in terms of lethal effects, i.e., a hyper-sensitive stage at fifth larval stadium, ranging from early fifth to early pupa, and a moderately sensitive stage at late pupal stage.

The former is characterized by a high number of embryos dying at an early embryonic stage, while the latter is scarcely marked by a particular stage of the dying embryos, but, if any, it would be the late embryonic stage.

With the purpose of eliminating the effect of irradiate cytoplasm upon lethality, observations were also made with dying embryos from the cross between irradiated males and non-irradiated females. The incidence and stage specificity of the dying embryos were in good accord for both sexes at the stage of highest mutability, i.e., fifth larval stadium day 6 in the male and late pupal stage in the female.

Increased incidence of dying embryos from eggs laid by females irradiated at a late pupal stage seems to be due to radiation-induced dominant lethals, while the marked increase in early dying embryos from eggs of the cross with males irradiated at fifth larval stadium cannot be attributed to dominant lethals; it is rather caused by disturbed egg plasma formation due to irradiation.

IX. SOME OBSERVATIONS RELEVANT TO THE POSSIBLE CAUSE OF RADIATION-INDUCED STERILITY IN MALE SILKWORM

By Mr Yataro TAZIMA.

An extremely sensitive stage to radiation was revealed early in the fifth stadium of the male silkworm (TAZIMA, 1956) and experiments to investigate the possible cause underlying this observation have been carried out.

When males are irradiated at this particular stage, and mated to non-irradiated females, most of the eggs laid are unpigmented and dry up at a very early stage.

Two alternative hypotheses have been postulated to explain the phenomenon. One is sterility of the irradiated male due to lack or inefficiency of sperms. The other is the killing of fertilized eggs during early cleavage by dominant lethals introduced with irradiated sperms. In the discussion of radiation-induced dominant lethality, it is essential to determine which of the two may be the cause of those unpigmented eggs.

The examination of the genital organs of non-irradiated females mated to irradiated males showed that a fairly large number of sperms were ejaculated into bursa copulatrix, while only very few sperms reached the receptaculum seminis. This indicates that though spermiogenesis, from the morphological point of view, was carried out almost normally most of the formed sperms were abortive. Thus, females mated to the irradiated males laid unpigmented eggs in the majority of cases with a few exceptions of normally pigmented ones, i.e., fertilized eggs and in addition some abnormal eggs with a few pigmented serosa cells.

The latter ones were also found with approximately the same frequency among the eggs laid by virgin females, which indicated that those serosa cells might have arisen from parthenogenetically developed nuclei.

This assumption was verified by double mating of irradiated males to non-irradiated females and to re females. The comparison of the coloration of the serosa cells of abnormal eggs between the two crosses showed that those eggs were the products of parthenogenesis excluding the possibility of fertilization by irradiated sperms.

The conclusion is that a high incidence of unpigmented eggs in F1 when the male was irradiated is probably caused rather by inefficiency of the germ cells than by dominant lethals which manifest themselves at an early cleavage stage.

X. CYTOLOGICAL STUDIES OF RADIATION-INDUCED STERILITY IN THE MALE SILKWORM.

By Mr Tashihiko SADO

In a recent report, TAZIMA (1958) demonstrated that the incidence of radiation-induced sterility in the silkworm differs with sex and age of the irradiated insects, and that an extremely sensitive stage occurs early in the fifth stadium of the male. A cytological study of the cause of these phenomena was undertaken by the present author.

Various doses of X-rays ranging from 100 r to 4000 r were given to silkworm larvae at the early fifth stadium with a dose rate of 147.7 r/min. Tests from irradiated insects were fixed at definite interval after irradiation and examined following the usual histological methods.

Several hours after irradiation pycnotic cells were observed in the gonial region, increasing in number from the time of irradiation up to 24 hours, when the highest incidence was observed. Afterwards, the necrotic cells rapidly liquefied and disappeared from the irradiated tests, resulting in a great reduction of the number of spermatogonia. Three days after irradiation at 1000 r or more, depletion of spermatogonia was almost complete but apical cells and primordial germ cells survived unaffected. The cell stage at which the first sign of degeneration was observed was that of late spermatogonia. This finding agreed with the observation in the grasshopper reported by UGGERI and COCCHI (1944) and by OAKBERG (1955) in mice, indicating that excessive sterility of irradiated males might have been caused by cell death resulting in the scarcity of sperm.

However, hypersensitivity of late spermatogonia alone does not explain satisfactorily the cause of excessive sterility of insects irradiated at early fifth stage because at that time most of the germ cells had already developed into spermatocytes.

Spermatocytes are less sensitive to X-rays than are spermatogonia. Cells irradiated at this stage underwent meiotic divisions without showing any pycnotic or necrotic changes. Degenerating sperms appeared,

however, in the tests of irradiated insects 12 days after irradiation at 1000 r, when irradiation took place at early fifth stage, and increased in number with the age of pupae. A quantitative histological study of the degenerating sperms is now in progress. It seems that the great majority of irradiated spermatocytes degenerate during the long course of spermiogenesis but some may develop into non-functional sperms.

XI. RECOVERY OF IRRADIATED SPERMATOGENIA OF THE SILKWORM AND THE STAGE LIMIT FOR THE PRODUCTION OF FUNCTIONAL SPERMS.

By Mr Toshihiko SADO.

It was found that silkworm spermatogonia, especially at their later stages, are easily killed by exposure to low X-rays doses. Much fewer spermatogonia are found in the tests at early fifth stadium than at early fourth stadium. It may be expected, therefore, that irradiation of males at the fourth stadium affects fertility stronger than that given at the fifth stadium. However, according to fertility tests, irradiation of males at early fourth stadium produces less fertility than that applied at early fifth stadium.

Hence the question arose whether less sterility in the former case was due to functional sperms produced from regenerated spermatogonia after irradiation. In order to answer it, the present experiment was undertaken. The results are as follows.

When male larvae were X-rayed at early fourth stadium with 1000 r of X-rays, complete depletion of spermatogonia was observed three days after irradiation but two days later regeneration occurred. However the number of regenerated spermatogonia was not sufficient by the time of the maturation of larvae.

In groups irradiated at earlier stages, regenerated spermatogonia could develop into spermatocytes 10 days after irradiation. These cells were histologically confirmed to differentiate into normal spermatozoa.

Fertility test showed that the recovered spermatogonia can develop into mature normal sperms, if the males were irradiated early enough in the life cycle, i.e., at the first or second stadium.

XII. DURATION OF SPERMATOGENESIS IN THE SILKWORM.

By Mr Tashihiko SADO.

In order to elucidate varying effects of irradiation on the successive stages of spermatogenesis in silkworm, it is important to know the onset and duration of each stage, especially when the recovery of irradiated spermatogonia is taken into consideration. No reports on this problem have been published so far either for the silkworm or other insects.

The answer would readily be obtained if in vitro culture of spermatogenic cells of silkworm were successful.

However, a crude estimate of the duration of cell development for each stage might be possible by recording the time of the first appearance of cells of one stage and that of the next one.

The tests of a newly hatched larva contains only a mass of primordial germ cells. Three days after hatching primary and secondary spermatogonia differentiate from them but spermatocytes do not yet appear. Differentiation of the spermatogonia into spermatocytes occurs first in the middle of the second instar, 5-6 days after hatching; At this stage, the spermatocytes are in synapsis. Then the third stadium develops, and a high incidence of differentiation of spermatogonia into spermatocytes is observed. Most spermatocytes enter into meiotic prophase I, which lasts fairly long until the larva reaches the 4th molting or very early 5th stadium (16-17 days after hatching), where upon cells in metaphase I are observed for the first time. Within a day after metaphase I spermiogenesis commences in the tests, which shows that the duration between metaphase I and the beginning of spermiogenesis is very short. At the end of the fifth stadium (22-23 days after hatching), spermatozoa appear in bundles in the tests.

The above description is based on the observation of the most advances among the germ cells. Most of the remaining cells develop about three or more days later.

Similar observation was made with irradiated tests. As reported previously, almost complete depletion of spermatogonia was observed three days after irradiation of male larvae with 1000 r X-rays but two days later regeneration occurred from surviving primordial germ cells. Regenerated germ cells entered into synaptic stage 8-9 days after irradiation and 17-18 days after irradiation some cells were seen in meiotic metaphase I while some others were in an early spermatid stage. They developed into mature spermatozoa 23-24 days after irradiation.

Based on these observations approximate estimation was made for the duration of each stage of spermatogenesis, as indicated in the table.

TABLE. APPROXIMATE TIMING OF CELL DEVELOPMENT IN THE SPERMATOGENESIS OF THE SILKWORM.

Stage of spermatogenesis	Duration
Spermatogonia	a few days
Spermatocytes	
Meiotic prophase I	10-11 days
Metaphase I - Anaphase II	within 1 day
Spermatids	5-6 days
Spermatozoa	---
Total spermatogenesis	about 20 days

ETUDE DES MUTATIONS GÉNÉTIQUES PAR
RADIATION CHEZ LE VER À SOIE

Résumé.

Cette étude comprenant 6 articles (art. VII à XII) vient en complément d'une étude publiée (art. I à VI) sous le même titre dans l'"Annual Report of the National Institute of Genetics, Japan".

TAZIMA étudie successivement la nature des mutations induites par radiations selon la méthode des loci spécifiques, les caractères léthaux dominants induits par irradiation aux rayons X aux différents stades de l'ovogénèse du Ver à soie. Il fait ensuite quelques observations sur les causes possibles de la stérilité du mâle induite par radiations.

SADO fait une étude cytologique de la stérilité des mâles induits par radiations; puis il décrit la reprise de vitalité des spermatogonies irradiées du Ver à soie et le stade limite de production des spermatozoïdes fonctionnels. Enfin, il s'efforce d'élucider les divers effets de l'irradiation sur la durée de la spermatogénèse.

BIBLIOGRAPHICAL ADDENDUM.

- TAZIMA (Y.) and ONIMARU (K.) - 1957. Radiation mutagenesis in the silkworm. I. Changes in sensitivity of silkworm germcells to X-rays at different stages of gametogenesis.
Annual Report of the National Institute of Genetics (Japan), 1957, n°8, pp. 71-73.
- TAZIMA (Y.) and ONIMARU (K.) - 1957. Radiation mutagenesis in the silkworm. II. Mutation response pattern of silkworm germcells to X-rays according to stage and sex.
Idem, 1957, n°8, pp. 73-74.
- TAZIMA (Y.) - 1957. Radiation mutagenesis in the silkworm. III. Comparison of X-ray induced mutation rates in the silkworm with those of Drosophila and Mouse.
Idem, 1957, n°8, pp. 74-75.
- TAZIMA (Y.) - 1958. Radiation Mutagenesis in the silkworm. IV. Independence of radiation intensity as shown by induced sterility of spermatogenic cells.
Idem, 1958, N°9, pp. 98-99.
- TAZIMA (Y.) and ONIMARU (K.) - 1958. Radiation mutagenesis in the silkworm. V. Further data on radiation-induced mutation rates in the silkworm.
Idem, 1958, N°9, pp. 99-100.
- SADO (T.) - 1958. Radiation mutagenesis in the silkworm. VI. Histological study of radiation sensitivity of spermatogenic cells of the silkworm (a preliminary note).
Idem, 1958, N°9, pp. 101-102.
-

11ème CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960

Deuxième Partie

S E C T I O N M A L A D I E S

Présidence : M. ARUGA H. (Japon).

Vice-Présidence : M. MASERA E. (Italie).

Rapporteur Général : M. VAGO C. (Italie).

THE INDUCTION OF, AND RESISTANCE TO
THE NUCLEAR AND CYTOPLASMIC POLYHEDROSES
IN THE SILKWORM.

By Mr Hisao ARUGA (Japan) (*).

There are two types of polyhedroses; nuclear and cytoplasmic, which affect the silkworm. Both of them are characterized by the presence of polyhedral inclusion bodies. In the nuclear polyhedrosis polyhedra are formed in the cell nuclei of several organs and tissues, while in the cytoplasmic type the site of polyhedra formation is restricted to the cytoplasm of cylindrical cells of the mid-gut.

INDUCTION.

A. FOOD QUALITY.

Recently it was found by some researchers that the cytoplasmic polyhedrosis of the silkworm was very prevalent in Japan. In our laboratory the occurrence of both polyhedroses has been studied mainly in the 4th and the 5th instar larvae either under the normal rearing conditions or under the stresses by means of low temperature, X-rays, ultraviolet rays and some chemical. In these five years. Under the normal rearing conditions the incidence of nuclear polyhedrosis was consistently low in any of the three rearing seasons, while that of cytoplasmic polyhedrosis was low in the spring rearing, medium in the summer rearing and high in the late autumn rearing. When the 5th instar larvae just after ecdysis were exposed to cold (5°C) for 24 hours, both nuclear and cytoplasmic polyhedroses broke out with much higher frequency than that in the control. This phenomenon is called induction. The induction rate of cytoplasmic polyhedrosis by the cold-treatment changed according to the rearing seasons and showed the same tendency as was observed under the normal rearing conditions.

(*) Mr Hisao ARUGA, Laboratory of Sericulture, Faculty of Agriculture, University of Tokyo (Japan).

TABLE 1. REARING SEASON AND INCIDENCE OF POLYHEDROSES.

	YEAR	REARING SEASON	T N ^o test larvae	N Nuclear polyhe- drosis (%)	NC Both po- lyhedro- ses (%)	C Cytoplas- mic poly- hedroses (%)	F Other disea- ses (%)	H Healthy larvae (%)
Control	1956	Spring	2.866	1.5	0.3	1.2	16.6	80.4
		Summer	1.197	1.5	2.8	10.6	18.0	67.1
		Late autumn	2.867	1.0	2.5	14.4	17.6	64.4
	1957	Spring	1.150	0.3	0.3	0.3	3.5	95.6
		Summer	2.371	0.6	1.8	3.6	3.6	90.4
		Late autumn	2.083	0.7	0.9	7.0	10.3	81.0
Gold treatment	1956	Spring	3.824	15.4	14.4	7.0	35.1	28.0
		Summer	1.451	2.8	26.0	15.8	18.7	36.7
		Late autumn	3.541	2.0	22.9	34.5	10.8	29.8
	1957	Spring	2.890	23.9	9.4	2.9	3.2	60.6
		Summer	1.581	20.4	35.5	14.5	8.0	21.6
		Late autumn	2.084	2.6	32.3	35.7	7.1	21.3

Numerous strains including hybrids and biochemical mutants were used. It is generally accepted in Japan that mulberry leaves harvested in spring are more suitable for the growth of silkworm larvae than those harvested in summer or in autumn. Judging from these facts mentioned above, it can be suggested that the quality of mulberry leaves might be a factor of considerable importance in the development of the cytoplasmic polyhedrosis and that the nutritional condition of larvae might modify the efficiency of induction of the polyhedrosis by some physical and chemical agents.

With this working hypothesis, the incidence of both polyhedroses in the larvae reared at Tokyo was compared with that in the larvae reared at Ueda, which was situated in the mountainous district in Nagano Prefecture. This experiment was based on the fact that the mulberry leaves harvested at Ueda were of higher quality than those harvested at Tokyo. The results revealed that the cytoplasmic polyhedrosis, whether spontaneous or induced, appeared at a higher frequency in the plots reared at Tokyo compared with that in the plots reared at Ueda. When the larvae were reared at Ueda until the 2nd instar and then transferred to Tokyo, the incidence of cytoplasmic polyhedrosis was intermediately high.

TABLE 2. REARING PLACE AND INCIDENCE OF POLYHEDROSES (SUMMER 1957).

	REARING PLACE	T	N (%)	NC (%)	C (%)	F (%)	H (%)
Control	Tokyo	49	0.0	51.0	32.7	2.0	14.3
	Ueda-Tokyo(*)	50	4.0	6.0	18.0	26.0	46.0
	Ueda	103	0.0	0.0	0.0	10.7	59.3
Cold-treatment	Tokyo	50	10.0	20.0	52.0	14.0	4.0
	Ueda-Tokyo(*)	50	12.0	14.0	12.0	42.0	20.0
	Ueda	56	60.7	0.0	0.0	17.9	21.4

(*) Reared at Ueda from the 1st to the 2nd instar and at Tokyo from the 3rd to the 5th instar. Silkworm strain : Ryo.

Further evidence was obtained by rearing silkworm larvae at Tokyo and feeding them from the 1st to the 3rd instar with mulberry leaves which had been sent from Ueda instead of leaves harvested at Tokyo. These larvae developed cytoplasmic polyhedrosis with much lower frequency compared with those fed with leaves harvested at Tokyo throughout the larval stage.

TABLE 3. QUALITY OF MULBERRY LEAVES AND INCIDENCE OF POLYHEDROSES.
(Late autumn, 1959).

STRAIN	MULBERRY LEAVES FED FROM ! THE 1st TO THE 3rd INSTAR	T-F	$\frac{N + NC}{T - F}$	$\frac{NC + N}{T - F}$	$\frac{NC}{T - F}$
			$\times 100$	$\times 100$	$\times 100$
Daizo x C4	Harvested at Tokyo	50	0.0	10.0	0.0
	Harvested at Ueda	49	0.0	4.1	0.0
C122 x N122	Harvested at Tokyo	36	5.3	64.0	5.3
	Harvested at Ueda	43	0.0	27.9	0.0

N° of test larvae (T) : 50.

To provide some information on the relation between the induction of polyhedroses and the quality of mulberry leaves, nutritional conditions of larvae were artificially changed by feeding them with mulberry leaves of various qualities. In the first set of experiments, larvae were fed with extremely soft and hard leaves, leaves shaded from sunlight or stored leaves from the 1st to the 3rd instar and with normal leaves during the 4th and the 5th instars. On entering the 5th instar, the larvae in each plot were divided into two groups. Cold-treatment was carried out on one group. The other group was not treated and kept as control. In the control those larvae fed with soft or shaded leaves developed cytoplasmic polyhedrosis at high frequency. It is very interesting to note that nuclear polyhedrosis was induced by cold-treatment only at low frequency among the larvae in these two plots.

TABLE 4. EFFECT OF NUTRITIONAL CONDITION FROM THE 1st TO THE 3rd INSTAR ON THE DEVELOPMENT OF POLYHEDROSES (SUMMER 1959).

MULBERRY LEAVES FED FROM THE 1st TO THE 3rd INSTAR	CONTROL				COLD-TREATMENT			
	T-F	N+NC	NC+C	NC	T-F	N+NC	NC+C	NC
	T-F	T-F	T-F	T-F	T-F	T-F	T-F	T-F
	x 100	x 100	x 100	x 100	x 100	x 100	x 100	x 100
Normal leaves	45	0.0	6.0	0.0	43	30.2	79.2	27.9
Soft leaves	24	0.0	20.8	0.0	19	0.0	89.4	0.0
Hard leaves	43	0.0	9.3	0.0	44	53.9	54.6	33.9
Shaded leaves	41	0.0	24.0	0.0	29	3.4	96.5	3.4
Leaves stored for 3 days	43	2.3	2.3	0.0	21	52.4	90.5	47.6
Leaves stored for 8 days	37	5.4	8.1	2.7	25	48.0	88.0	44.0

Silkworm strain : C122 x N122, N° of test larvae (T) : 50.

In the second set of experiments, the nutritional conditions were changed only during the 4th instar. It was found that feeding of soft leaves and leaves stored for 8 days made the larvae more liable to develop the cytoplasmic polyhedrosis in the control but less liable to develop nuclear polyhedrosis in the induction by cold-treatment.

TABLE 5. EFFECT OF NUTRITIONAL CONDITION DURING THE 4th INSTAR ON THE DEVELOPMENT OF POLYHEDROSES (Spring 1959).

MULBERRY LEAVES FED DURING THE 4th INSTAR	Control				Cold-treatment			
	T-F	N+NC	NC+C	NC	T-F	N+NC	NC+C	NC
	T-F	T-F	T-F	T-F	T-F	T-F	T-F	T-F
	x 100	x 100	x 100	x 100	x 100	x 100	x 100	x 100
Normal leaves	48	0.0	6.2	0.0	47	40.4	78.7	38.3
Soft leaves	41	4.8	29.2	2.4	46	23.9	95.7	23.9
Hard leaves	47	0.0	4.3	0.0	50	44.0	68.0	40.0
Leaves stored for 3 days	48	2.1	14.5	2.1	43	41.9	76.7	37.2
Leaves stored for 8 days	47	2.1	34.0	2.1	43	14.0	79.1	14.0
Starch-smear leaves	49	0.0	10.2	0.0	45	42.3	84.5	40.0

Silkworm strain : C122 x N122, N° of test larvae (T) : 50.

Summarizing the above-mentioned results, it seems that the quality of mulberry-leaves plays a very important part in the spontaneous or induced development of both nuclear and cytoplasmic polyhedroses. Development of nuclear polyhedrosis is favored by such nutritional condition as can be regarded to be relatively suited for the growth of silkworm lar-

vae. On the contrary bad nutritional conditions give rise to the cytoplasmic polyhedrosis.

B. LOW TEMPERATURE.

In our laboratory various physical and chemical agents were tested for the inducing effect of both nuclear and cytoplasmic polyhedroses. Among them low temperature (5° C) has been most extensively used to study the mechanism of induction, because it was not only efficient in the induction but also much suited for a simple and accurate experimentation.

To clarify the mechanism of the induction of nuclear polyhedrosis, implantation experiments were made. Cold-treatment was carried out on 3 larvae just after the 4th ecdysis. Four days later small pieces of trachea and adipose tissue were removed from each of them. These pieces were then implanted into 7 or 10 healthy pupae. At the time of implantation no polyhedra were detectable in the tissues of the donor larvae. A second group of 42 pupae, which were kept as controls, received tissue pieces from about 40 untreated larvae just after the 4th ecdysis. All the recipient pupae of the tissue from the treated larvae succumbed to the nuclear polyhedrosis on the seventh day except for one that had died of other disease. On the other hand, no pupa died of polyhedral disease among those pupae that had received tissue pieces from untreated larvae. Thus, it may be concluded that, under these conditions, induction and multiplication of nuclear virus take place in a part of refrigerated larvae.

TABLE 6: ASSAY OF NUCLEAR VIRUS IN LARVAL TRACHEA AND ADIPOSE TISSUE BEFORE AND AFTER COLD-TREATMENT (Spring 1959).

KIND OF DONOR LARVAE	N° recipient pupae	N° diseased pupae	Class of diseases pupae		N° emerged individuals
			Nuclear polyhedrosis	Other diseases	
REFRIGERATED LARVAE	N°1	7	7	0	0
	N°2	10	9	1	0
	N°3	10	0	2	8
UNREFRIGERATED LARVAE		42	0	15	27

Refrigeration temperature : 0-4° C.

In the second set of experiments, continuous and intermittent cold-treatments were carried out for various lengths of time on the 5th instar larvae just after ecdysis. Intermittent cold-treatment consisted in refrigeration interrupted every 8 hours with warming (30° C.) for half an hour. In all the different groups of treated larvae, development of poly-

hedroses took a similar course which could be summarized as follows. Both nuclear and cytoplasmic polyhedroses appeared sporadically up to 4 days after the treatment. On the following day, however, the diseased larvae increased abruptly in number. This peak was then followed by rapid decrease.

Cold-treatment for 8 hours resulted in slight increase in the incidence of both polyhedroses. When the length of cold-treatment was prolonged to 16 hours, marked increase was observed in the percentage of polyhedroses. However, further prolongation to 24 hours did not bring about any significant change as for the induction rate; the percentage remained as high as in the case of 16-hours treatment. Sixteen-hour intermittent cold-treatment was more effective in the induction than 16- or 24-hour continuous treatment. Induction rate of nuclear polyhedrosis was much higher when the length of intermittent cold-treatment was extended to 24 hours. From these results it may be considered that induction rate of both polyhedroses is controlled not only by the length of refrigeration but also by the number of time of the abrupt change in larval body temperature.

TABLE 7. PROPORTION OF INDUCED LARVAE AS A FUNCTION OF TIME OF REFRIGERATION (Late autumn, 1958).

HOURS OF REFRIGERATION	T	T - F	$\frac{N + NC}{T - F}$ x 100	$\frac{NC + C}{T - F}$ x 100	$\frac{NC}{T - F}$ x 100
0	80	59	3.4	11.9	0.0
8	80	63	7.9	20.6	4.8
16	80	54	24.1	44.4	16.7
24	80	58	17.2	36.2	10.0
8 + 8*	80	63	44.4	63.5	36.7
8 + 8 + 8*	79	51	70.6	62.8	41.2

(*) indicates intermittent cold-treatment. Silkworm strain : C108 x N1.
Refrigeration temperature : 0 - 3° C.

Silkworm stage plays an important part in the efficiency of induction by controlling the "aptitude" of the silkworm, which we define as the ability to respond to cold-treatment by the development of polyhedroses. It was found that until the 3rd moult the aptitude remained so low that we could not induce polyhedroses by cold-treatment. By refrigerating the 4th instar larvae before first feeding after ecdysis, both polyhedroses were induced at considerably high frequency. During the 4th moult the aptitude became low again, whereas after the 4th ecdysis it rapidly increased and reached a very high level which was maintained for several hours. In contrast to these larvae before first feeding after the 4th ecdysis, those in the later stage showed much lower aptitude. The actual mechanism by which aptitude varies is as yet unknown. But it is possible that the variation of aptitude may be controlled by hormones concerned with metamorphosis.

TABLE 8. EFFECT OF SILKWORM STAGE ON THE EFFICIENCY OF INDUCTION BY COLD-TREATMENT (1958).

REARING SEASON	SILKWORM STAGE AT THE TIME OF REFRIGERATION	T	T-F	$\frac{N+NC}{T-F}$	$\frac{NC+C}{T-F}$	$\frac{NC}{T-F}$
				x 100	x 100	x 100
SUMMER	Control (4th instar)	20	19	3.4	11.9	0.0
	4th instar just after ecdysis	20	18	17.2	36.2	10.3
	Control (5th instar)	80	73	0.0	2.7	0.0
	4th moult	60	52	0.0	0.0	0.0
	0.0 - 0.5	79	68	44.1	27.9	25.0
	Hours after 3.0 - 3.5	79	76	77.7	48.7	46.1
	4th ecdysis 6.0 - 6.5	80	67	76.1	43.3	38.8
	12.0 - 12.5	80	75	78.7	53.4	50.7
SPRING	Control (5th instar)	40	40	2.5	0.0	0.0
	4th moult	42	38	5.3	0.0	0.0
	0.0 - 0.5	35	33	6.1	3.0	3.0
	Hours after 5.0 - 5.5	40	40	95.0	22.5	22.5
	4th ecdysis 10.0 - 10.5	40	38	76.4	34.3	29.0
	Days 1	40	39	5.1	0.0	0.0
	after 2	39	34	32.4	0.0	0.0
	post- 3	38	34	5.9	0.0	0.0
	ecdysis 4	40	37	5.4	0.0	0.0
	feeding 5	43	39	28.2	0.0	0.0
	6	40	39	15.4	0.0	0.0
	7 (matured)	40	33	3.0	0.0	0.0
	8 (spinning)	39	39	0.0	0.0	0.0
	9 (spinning)	41	29	0.0	0.0	0.0
	10 (pupae)	20	15	0.0	0.0	0.0

Silkworm strains : C108 x N1, N1 x C108 and C108 x Okusa

Refrigeration temperature : 3-7° C in summer and 0-4° C in spring.

After cold-treatment the fate of the larvae is not entirely determined and the development of both polyhedroses can be prevented by starvation. When the 5th instar larvae were refrigerated before the first feeding after ecdysis and starved for more than 24 hours after the cold-treatment, the incidence of both polyhedroses was greatly decreased. This result indicates that the reactions provoked by cold-treatment are reversible.

TABLE 9. EFFECT OF STARVATION AFTER COLD-TREATMENT ON THE INDUCTION RATE. (Spring, 1959).

HOURS OF STARVATION PERIOD	T - F	$\frac{N + NC}{T - F} \times 100$	$\frac{NC + C}{T - F} \times 100$	$\frac{NC}{T - F} \times 100$
0	47	36.4	72.5	29.5
12	49	37.8	91.1	37.8
24	50	0.0	11.1	0.0
36	48	0.0	25.0	0.0
48	48	0.0	14.9	0.0

Silkworm strain : C122 x N122, N) of treated larvae : 50.

When the 5th instar larvae before post-ecdysis feeding were irradiated with X-rays (10,000 r), neither nuclear nor cytoplasmic polyhedrosis was induced. However, if the irradiation was carried out before or after cold-treatment, the rate of induction of both polyhedroses was greatly increased.

TABLE 10. EFFECT OF X-IRRADIATION ON THE INDUCTION BY COLD-TREATMENT. (1959).

TREATMENT	SPRING				SUMMER			
	N+NC		NC+C		N+NC		NC+C	
	T-F	T-F	T-F	T-F	T-F	T-F	T-F	T-F
	x 100	x 100	x 100	x 100	x 100	x 100	x 100	x 100
Control	50	0.0	0.0	0.0	48	0.0	26.0	0.0
Cold-treatment	50	12.0	12.0	0.0	38	10.5	47.4	10.5
X-irradiation followed by cold treatment	50	20.0	36.0	20.0	36	22.2	77.8	22.2
Cold treatment followed by X-irradiation	50	16.0	44.0	16.0	42	19.0	71.5	19.0
X-irradiation	50	0.0	0.0	0.0	42	0.0	28.5	0.0

Silkworm strain : L C122 x N122.

C. CHEMICALS.

Ethylene diamine tetraacetic acid (EDTA) and its disodium salt (Na-EDTA) induced cytoplasmic polyhedrosis with high frequency when they were fed to the 5th instar larvae but only with low frequency when fed to the 4th instar larvae. Although the larvae reared at Tokyo developed only cytoplasmic polyhedrosis in the experiments mentioned above, those reared at Ueda developed both nuclear and cytoplasmic polyhedroses. These results suggested that inducing action of these chemicals might be modified by the physiological conditions of the silkworm in the same way as that of low temperature. It was noteworthy that induction ratio was nearly proportional to the concentrations of the chemicals.

TABLE 11. INDUCTION OF POLYHEDROSES BY FEEDING EDTA OR ITS DISODIUM SALT. (Late autumn, 1959).

Silkworm strain	Daizō x C4 (Tokyo)			Shūngetsu x Ryo (Ueda)				
Chemical feeding	During 5th instar (3 times a day)			During 4th and 5th instars (once a day)				
	T	T-F	C	T	T-F	N+NC+C	N+NC	NC+C
			$\frac{T-F}{T} \times 100$			$\frac{T-F}{T} \times 100$	$\frac{T-F}{T} \times 100$	$\frac{T-F}{T} \times 100$
Control	50	50	0.0	50	47	2.1	2.1	0.0
EDTA 0.5 M	25	21	90.5	18	18	88.9	11.1	83.2
0.25 M	25	24	79.1	25	25	52.0	36.0	20.0
0.1 M	25	20	65.0	22	21	33.3	19.0	19.0
0.05 M	25	25	32.0	25	23	8.7	4.3	4.3
Control	50	50	0.0	50	47	6.4	4.3	2.1
Na-EDTA 0.5 M	25	17	64.6	23	22	40.9	27.2	18.2
0.25 M	25	15	73.3	24	23	26.0	17.4	8.7
0.1 M	24	23	54.8	73	73	21.9	21.9	9.6
0.05 M	25	25	48.0	25	25	12.0	8.0	4.0

When cold-treatment was carried out on the 4th instar larvae that had been fed with Na-EDTA during the 3rd instar, cytoplasmic polyhedrosis was induced among them at higher percentage than the control value. It may be considered that the inducing actions may be additive.

TABLE 12. COMBINED EFFECTS OF CHEMICAL TREATMENT AND COLD-TREATMENT.
(Late autumn, 1959).

TREATMENT		T	T - F	C	NC
				T - F x 100	T - F x 100
Control	No treatment	50	50	0.0	0.0
	Cold treatment	50	45	8.9	0.0
Feeding of 0.05 M Na-EDTA	No treatment	40	39	0.0	0.0
	Cold treatment	50	41	36.7	2.4

Silkworm strain : *Usizo* x *C4*.

Cytoplasmic polyhedrosis could also be induced by feeding or injection of nitrogen mustard in the 3rd, the 4th or the 5th instar.

TABLE 13. INDUCTION OF CYTOPLASMIC POLYHEDROSIS BY NITROGEN MUSTARD.
(Summer, 1957).

Silkworm strain	Instar at the time of treat- ment	Treatment	T	N	NC	C	F	H
				(%)	(%)	(%)	(%)	(%)
<i>C4</i> x <i>od</i> : <i>od</i>	3rd	Control	50	0.0	0.0	0.0	2.0	98.0
		Feeding	50	0.0	0.0	78.0	22.0	0.0
<i>Ryo</i> x <i>Shūka</i>	4th	Control	50	0.0	2.0	4.0	6.0	88.0
		Feeding	50	2.0	0.0	54.0	38.0	6.0
<i>Ryo</i> x <i>Shūka</i>	5th	Control	98	0.0	0.0	0.0	6.2	91.8
		Feeding	55	1.8	0.0	13.2	79.3	5.7
		Injection	46	0.0	0.0	15.2	84.8	0.0

RESISTANCE.

Inheritance of resistance to nuclear and cytoplasmic polyhedrosis had been studied using many normal strains, their hybrids and some biochemical mutants. Biochemical mutants called lemon yellow (*lam*), which contained xanthopterin-B in the integument were found to be more susceptible to the nuclear polyhedrosis than the normal segregants. The *od* oily gene is pleiotropic and expresses its action in almost all of the organs and tissues of ectodermal origin. More larvae died of cytoplasmic polyhedrosis (C) among *od* oily mutants than among normal segregants, while the percentage of those larvae in which developed both nuclear and cytoplasmic polyhedrosis (NC) was lower among *od* oily mutants.

In the genetical experiments using normal strains showing different degrees of resistance to cytoplasmic polyhedrosis, no major genes were found to control the resistance. It might be considered that the resistance is controlled by polygenes. A series of backcross experiments indicated that maternal cytoplasm also plays a role in the resistance of the progeny to the cytoplasmic polyhedrosis.

Among various inbred lines Daizo and Shungetsu are resistant, while Ryo and Shūka are susceptible, to the cytoplasmic polyhedrosis. The incidence of polyhedroses was studied on the 5th instar larvae of these 4 inbred lines and F₁ hybrids among them. In order to compare the resistance between hybrids and their parental lines, the potence was calculated by the following formula:

$$\frac{F_1 - MP}{(P - MP)} \quad F_1 : \text{polyhedrosis percentage in } F_1$$

$$MP : \text{mid-parental polyhedrosis percentage}$$

$$P : \text{polyhedrosis percentage in either one of the parents.}$$

The results revealed that the potence of both polyhedroses was lower in F₁ hybrids than in their parental lines. Thus, F₁ hybrids showed heterosis for the resistance to the two types of polyhedroses. It was also found that the amount of heterosis in the resistance to cytoplasmic polyhedrosis tended to be larger than to nuclear polyhedrosis. On the contrary, when cold-treatment was carried out on the 5th instar larvae just after ecdysis, the incidence of nuclear polyhedrosis was generally higher in F₁ hybrids than inbred lines. As for the incidence of cytoplasmic polyhedrosis, similar tendency was observed in the spring rearing, but in the summer and late autumn rearings hybrids showed the medium degree of resistance between those of two parental lines. We should like to ascribe the difference in resistance between hybrids and parental lines to physiological conditions which are controlled by genetical factors.

TABLE 14. POTENCE OF POLYHEDROSIS PERCENTAGE IN F₁ HYBRIDS COMPARED WITH THAT OF PARENTS UNDER THE NORMAL REARING CONDITIONS OR UNDER THE STRESS OF LOW TEMPERATURE.

REARING SEASON	STRAIN	CONTROL		COLD-TREATMENT	
		N + NC	NC + C	N + NC	NC + C
SUMMER 1957	Ryo x Daizo	- 1.00	- 1.05	+ 1.51	0.00
	Daizo x Ryo	- 0.99	- 1.00	+ 0.92	- 0.20
	Daizo x Shungetsu	- 1.00	- 1.62	+ 1.54	+ 0.38
	Shungetsu x Daizo	- 1.00	- 1.62	- 0.64	- 0.56
	Ryo x Shungetsu	- 1.05	- 1.18	+ 1.48	- 1.71
	Shungetsu x Ryo	- 1.05	- 1.15	+ 0.45	- 1.31
AUTUMN 1957	Ryo x Daizo	- 1.00	- 1.00	- 57.00	+ 0.15
	Daizo x Ryo	- 1.00	- 1.00	- 5.11	- 0.46
	Ryo x Shungetsu	- 1.00	- 1.73	+ 4.59	+ 0.10
	Shungetsu x Ryo	- 1.00	- 1.73	+ 14.53	- 0.15
SPRING 1958	Shungetsu x Daizo			+ 34.84	+ 1.99
	Shūka x Daizo			+ 2.23	+ 32.25
	Shungetsu x Shūka			+ 1.84	+ 6.47
	Shūka x Shungetsu			+ 2.22	+ 2.83

Judging from the results so far obtained by us and other investigators, it may be presumed that both types of polyhedral viruses are pre-existent in the organism. The viruses may be in non-infective state, since when we transplanted larval tissue pieces into pupa, which is known to be very susceptible to intralymphal inoculation none developed the nuclear polyhedrosis. The process of induction could be visualized as follows. The inducing stress disturbs the physiological conditions of the silkworm, culminating in an abnormal condition which causes the transition of the viruses from a non-infective to an infective state. We are inclined to postulate that the viruses in inactive state can be transmitted from generation to generation. Investigations in this line are now in progress.

REFERENCES.

- ARUGA (H.) - 1957. Mechanism of resistance to virus diseases in the silk worm, Bombyx mori. (II) On the relation between the nuclear polyhedrosis and the cytoplasmic polyhedrosis. J. Sericult. Sci. Japan, 26: 279-283.
- - 1958a. Mechanism of resistance to virus diseases in the silk worm, Bombyx mori. (IV) On the relation between the polyhedral diseases and environmental factors. J. Sericult. Sci. Japan 27: 5-9.
- - 1958b. Mechanism of resistance to virus diseases in the silk worm, Bombyx mori. (V) On the induction of the polyhedral virus by nitrogen mustard. J. Sericult. Sci. Japan 27: 10-13.
- - 1958c. Mechanism of resistance to virus diseases in the silk worm, Bombyx mori. (VI) On the relation between the rearing season and the cytoplasmic polyhedrosis. J. Sericult. Sci. Japan 27: 14-17.
- ARUGA (H.) and ARAI (M.) - 1959. Studies on the induction of polyhedroses by the low temperature treatment in the silkworm, Bombyx mori. J. Sericult. Sci. Japan 28: 362-368.
- ARUGA (H.) and HUKUHARA (T.) - 1960. Induction of nuclear and cytoplasmic polyhedroses by feeding of some chemicals in the silkworm, Bombyx mori L. J. Sericult. Sci. Japan 29: 44-49.
- ARUGA (H.) and NAGASHIMA (E.) - On the relationship between the incidence of polyhedral diseases and the nutritional conditions during the larval stage in the silkworm, Bombyx mori L. (in preparation).
- ARUGA (H.) and WATANABE (H.) - 1959. Difference in induction rate of polyhedroses by low temperature treatment between inbred lines and their hybrids in the silkworm, Bombyx mori L. J. Sericult. Sci. Japan 28: 302-307.

ARUGA (H.), KANAI (E.) and ISRANGKUL NA AYUDHYA (A.) - 1959. On the relationship between physiological conditions of larvae and the induction of polyhedroses in the silkworm, Bombyx mori. J. Sericult. Sci. Japan 28: 369-374.

ARUGA (H.), YOSHITAKE (N.) and HUKUHARA (T.). Effect of X-irradiation on the induction by cold-treatment in the silkworm, Bombyx mori L. (in preparation).

HUKUHARA (T.) and ARUGA (H.) - 1959. Induction of polyhedroses by temperature treatment in the silkworm, Bombyx mori L. J. Sericult. Sci. Japan 28: 235-241.

L'INDUCTION DES VIROSES NUCLEAIRES
ET CYTOPLASMIQUES CHEZ LE VER A SOIE.
RESISTANCE A CES FORMES DE VIROSES.

Résumé.

Il existe deux types de viroses qui affectent le Ver à soie : la virose nucléaire et la virose cytoplasmique. Toutes deux sont caractérisées par la présence de corps d'inclusion polyédriques.

L'étude de l'induction de ces viroses est particulièrement aisée chez les vers aux 4ème et 5ème âges. Le taux d'induction change selon les saisons d'élevage, il est aussi fonction de l'altitude des lieux d'élevage. Il semble que le développement de la virose nucléaire soit favorisé par des conditions semblables à celles qui sont favorables à la croissance des larves de vers à soie.

La qualité de la feuille de mûrier paraît être un important facteur dans le développement de la virose cytoplasmique. En outre, les conditions d'alimentation des larves peuvent modifier l'incidence de la virose.

L'auteur étudie l'induction provoquée par les basses températures, par les agents chimiques. Il étudie la résistance des vers à soie à la virose nucléaire et à la virose cytoplasmique.

11ème CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960.

ETUDE DE L'EFFET DES PREPARATIONS INSECTICIDES
D.D.T. ET HEXACHLORAN SUR LES VERS A SOIE.

Par M. Ivan KOJOUKHAROFF (Bulgarie) (*).

(Original)

Depuis ces dernières années les préparations insecticides DDT et Hexachloran sont largement utilisées dans l'agriculture pour lutter contre les insectes nuisibles aux cultures herbacées et forestières. C'est l'utilisation en masse de ces préparations qui a imposé la participation la plus active de l'aviation rurale pour qu'on puisse asperger dans le plus court délai les plantes cultivées.

Dans ce cas là on trouve assez souvent sur les terrains aspergés, des mûriers ou bien des plantations de mûriers dont les feuilles sont saupoudrées ainsi que les autres cultures menacées d'insectes nuisibles. Le saupoudrage des feuilles des mûriers est fait à un degré tel qu'on les rend hors d'état d'être utilisées parce que les vers à soie, nourris de ces feuilles meurent.

Dans notre pays il y a beaucoup de cas de mortalité des vers à soie, nourris de feuilles saupoudrées de DDT.

C'est à cause des constatations déjà faites que nous avons entrepris la présente étude dont le but est d'établir surtout pour la pratique quels sont les dégâts sur les vers à soie nourris de feuilles saupoudrées de préparations insecticides de DDT et d'Hexachloran et dans quelles conditions on pourrait utiliser les mûriers saupoudrés pour nourrir les vers à soie.

Pour faciliter notre travail nous avons cherché dans la littérature scientifique des renseignements concernant l'influence des préparations ci-dessus mentionnées sur les vers à soie dans les mêmes conditions ou très proches de celles de notre recherche malheureusement nous n'en avons pu trouver.

(*) M. Ivan KOJOUKHAROFF, Chargé de Recherches, Chef de la Section Sérícicole à l'Institut Central de Zootechnie (Académie Bulgare des Sciences) Sofia-Kostinbrode, Bulgarie.

METHODE ET MATERIEL.

L'expérimentation a été faite successivement au cours de deux saisons séricicoles : 1958 et 1959 sur les vers à soie de la race jaune indigène pendant leur 5ème âge.

Dans ce but on les classait en 3 groupes (chacun contenant 200 vers à soie) pour chaque variante.

On nourrissait les vers à soie ensemble pendant les quatre périodes et l'on formait les groupes au début du cinquième âge. Nous avons pris les vers à soie du cinquième âge parce qu'au début, pendant les quatre premiers âges ils mangent très peu de feuilles - environ 20 % de la quantité nécessaire et qu'alors on peut leur fournir des feuilles non saupoudrées de lieux éloignés, tandis qu'au cinquième âge ils consomment environ 80 % de la nourriture nécessaire et on est obligé alors d'utiliser tous les mûriers pour nourrir les vers à soie.

On nourrissait les vers à soie pendant le 5ème âge avec des rameaux 5 ou 6 fois par jour. Aux groupes d'expérimentation on ne donnait que des feuilles saupoudrées pendant tout le 5ème âge et à ceux du contrôle des feuilles normales - sans préparation de DDT.

Le saupoudrage des feuilles a été fait pour qu'on puisse donner aux variantes d'expérimentation simultanément la nourriture qui était saupoudrée depuis 5, 10 ou 15 jours.

La température dans la magnanerie variait de 23° à 25° C. pendant les premiers âges et de 21 à 23° C. pendant les deux derniers.

Pendant les nuits froides, la température s'abaissait de 1 à 2°.

L'humidité de l'air dans la magnanerie variait entre 65 et 77 %.

En 1958, nous avons essayé 5 % de DDT et 12 % d'Hexachloran sur 33 groupes de 200 vers à soie dans 11 variantes; chaque variante comprenait 3 groupes.

Le cinquième jour après le saupoudrage il y eut une petite pluie, 13 litres par m², 5 jours plus tard on eut presque la même quantité d'eau et 12 jours après le saupoudrage - une pluie abondante. C'est à cause de tout cela qu'on abandonna la variante 15 jours après le saupoudrage.

Les vers à soie de la 5ème et de la 6ème variante étaient prélevés d'un groupe éclos plus tard. Les feuilles employées pour la nutrition n'étaient pas mouillées par la pluie. Les données du saupoudrage sont jointes au tableau 1.

En 1959, on a observé 33 groupes contenant 200 vers à soie en 11 variantes de 3 groupes chacune. Les conditions de l'élevage des vers à soie étaient presque les mêmes que celles de l'année précédente.

Le saupoudrage des feuilles est fait de la manière indiquée au tableau 2.

Il faut souligner que la période de la deuxième moitié de l'élevage des vers à soie était très pluvieuse - il pleuvait presque chaque jour ou bien tous les deux jours (196 litres par m² pendant le mois).

Pour préserver du lavage les feuilles saupoudrées destinées aux variantes de la 1ère à la 8ème inclusivement (tableau 2) les mûriers étaient recouverts de polyéthylène. A cause des pluies fréquentes pendant la moitié de la journée et pendant toute la nuit les mûriers étaient recouverts de polyéthylène. Grâce à cela les préparations dont les feuilles étaient saupoudrées ne furent pas lavées par les pluies.

Les mûriers destinés aux variantes 9 et 10 n'étaient pas couverts et ainsi les feuilles saupoudrées furent tout à fait lavées.

RESULTATS DE LA RECHERCHE.

Nous avons établi les principales indications suivantes concernant l'action des préparations insecticides sur l'état des vers à soie :

1) Vitalité des vers à soie - c'est à dire le nombre de vers ayant absorbé DDT et Hexachloran en même temps que la nourriture restés vivants et ayant fait leurs cocons,

2) Richesse soyeuse des cocons obtenus des vers des différentes variantes,

3) Poids moyen d'un cocon.

Les résultats de l'expérience sont enregistrés dans les tableaux 1 et 2.

Les données du tableau 1 pour l'expérience de 1958 indiquent que les feuilles saupoudrées de DDT n'ont pas eu un effet négatif sur les vers à soie de toutes les variantes. C'est à cause de la pluie, 14,6 litres par m², le cinquième jour après le saupoudrage qui a lavé les feuilles qu'on donnait aux vers à soie.

Sur les feuilles examinées après la pluie à la loupe ordinaire, on ne constatait aucune trace des insecticides.

On n'a remarqué que de faibles perturbations nerveuses chez les vers à soie de la cinquième et de la sixième variante, chez lesquels les feuilles données aux vers à soie n'étaient pas mouillées par la pluie. Mais sur eux le soleil et l'air ont eu une influence assez sensible.

Les renseignements sur la vitalité des vers à soie, le poids de cocons et la richesse soyeuse des cocons indiquent les mêmes résultats.

Des résultats obtenus en 1959 indiqués au tableau 2 on voit un état des vers à soie assez différent de celui obtenu en 1958.

Cette année, comme on vient de l'indiquer, les mûriers étaient couverts de polyéthylène pour préserver les feuilles de l'influence de la pluie.

Dans ce cas la les vers à soie qui avaient à manger des feuilles saupoudrées d'une préparation de 5 % de DDT (3 kg pour 10 ares ou 1.000 m²), 5 jours après le saupoudrage, eurent une perturbation nerveuse assez forte, 37,55 % de ces vers résistèrent et ceux qui reçurent des feuilles saupoudrées d'une préparation de 5 % de DDT (1,5 kg pour 10 ares) 5 jours aussi après eurent des perturbations plus faibles et 67,15 % survécurent.

Les vers à soie qui ont été nourris dans les mêmes conditions avec des feuilles saupoudrées de 1,5 et de 3 kg pour 10 ares, de 12 % d'Hexachloran dans le même intervalle du saupoudrage - 5 jours, eurent de faibles perturbations sans mortalité en masse.

Dans les autres variantes les vers à soie qui ont reçu des feuilles 10 jours après le saupoudrage avec DDT ainsi que Hexachloran n'ont pas été troublés dans leur nutrition. Cela peut être expliqué par l'influence du soleil et de l'air sur les préparations durant une période deux fois plus grande. Les vers à soie, de la variante 9 et 10 qui avaient reçu des feuilles saupoudrées mais lavées de la pluie passèrent leur 5ème période sans aucune perturbation.

Les petites différences indiquées concernant la vitalité des vers à soie de toutes les variantes excepté ceux de la variante 1, II sont dues à une faute négligeable et n'ont pas d'importance pour les conclusions définitives.

En analysant les résultats des recherches faites durant deux années sur l'état des vers à soie, on peut faire les conclusions suivantes :

1. Les mûriers saupoudrés d'une préparation (poudre) de 5 % de DDT, (1,5 Kg et 3 kg pour 10 ares) sont dangereux pour les vers à soie durant les dix jours après le saupoudrage. L'effet de la préparation DDT diminue sensiblement dix jours après le saupoudrage.

2. L'effet de 12 % d'Hexachloran employé dans les mêmes conditions que celles de 5 % de DDT est sensiblement plus faible que celui du DDT dans la nutrition des vers à soie avec des feuilles saupoudrées.

3. Une pluie de 12-13 litres par m² après le saupoudrage des feuilles des mûriers lave les feuilles de la poudre des préparations insecticides et les rend aptes à nourrir des vers à soie.

4. Les préparations insecticides n'ont pas une influence particulière sur le poids et la richesse soyeuse des cocons des vers qui ont pu faire deux cocons.

Ayant tiré ces conclusions basées sur les recherches de deux années, on peut donner :

LES AVIS SUIVANTS POUR LA PRATIQUE.

1. Pour préserver les vers à soie de l'effet du DDT et de Hexachloran, il faut installer les plantations de mûriers là où les cultures voisines n'ont pas besoin d'être saupoudrées d'insecticides, qui peuvent

atteindre les mûriers. Tois de petits terrains irréguliers abandonnés au bout des grandes parcelles ou des terrains qui sont loin des grandes parcelles.

2. Les rameaux des mûriers saupoudrés d'insecticides doivent être bien lavés avec de l'eau, si c'est nécessaire de les employer pour nourrir des vers à soie durant les dix jours qui suivent le saupoudrage des feuilles.

3. Quand 10 ou 12 jours se sont écoulés après le saupoudrage des mûriers ou bien s'il a plu et qu'on ne peut dire à quel degré cette pluie a lavé les feuilles des mûriers, on peut utiliser celles-ci après en avoir nourri un jour 100 vers à soie. Si les vers à soie mangent tranquillement sans dresser la tête vers le haut on peut leur donner les feuilles sans aucun danger.

4. Après une pluie abondante (au moins 14-15 litres par m²), on peut donner aux vers à soie des feuilles de mûriers récemment saupoudrées de préparations insecticides.

STUDY ON THE EFFECT OF DDT AND HEXACHLORAN INSECTICIDES PREPARATIONS ON THE SILKWORMS.

Summary.

The author studies the behaviour of silkworms reared on mulberry-leaves powdered with DDT and Hexachloran coming from the neighbour cultures which have been treated with those insecticides spraid in the fields by air.

Experiments were carried out in 1958 and 1959 on a great number of larvae belonging to many varieties.

The author concludes that in practice :

1. It is necessary to avoid the neighbourhood of treated cultures for the mulberry plantations;

2. One must wash in water the mulberry branches which have been in contact with insecticides for ten days after the spraying in the fields;

3. One can give polluted mulberry-leaves to the silkworms after an abundant rain (14 to 15 litres per m²).

TABLEAU 1 - 1958.

Variantes	Nombre de groupes	Vers à soie par groupes	Préparation kg/1000m ²	Concentration de la préparation	Alimentation des vers Nombre de jours après saupoudrage	Vitalité (%)	Richesse soyeuse (%)	Poids moyen d'un cocon frais (g)	Effets visibles des préparations sur les vers à soie
1	3	200	3	5 % DDT	5	93.7	46.44	2.660	Les vers à soie se nourrissent sans perturbations nerveuses visibles.
2	3	200	1.5	"	5	92.0	44.61	2.456	" " "
3	3	200	3	12 % Hexachl.	5	84.7	45.35	1.997	Faible mortalité sans perturbations nerveuses visibles
4	3	200	1.5	"	5	91.3	44.64	2.363	Les vers se nourrissent normalement sans perturbations nerveuses visibles
5	3	200	3	5 % DDT	5	95.0	42.86	1.981	Les vers à soie se nourrissent mais faibles perturbations nerveuses
6	3	200	3	12 % Hexachl.	5	93.8	43.59	2.181	" " "
7	3	200	3	5 % DDT	10	93.8	45.68	2.516	Les vers à soie se nourrissent sans perturbations nerveuses visibles
8	3	200	1.5	"	10	-	45.40	2.202	" " "
9	3	200	3	12 % Hexachl.	10	97.0	44.58	2.418	" " "
10	3	200	1.5	"	10	91.3	45.32	2.337	" " "
11	3	200	-	Contrôle	-	97.5	44.40	2.105	" " "

Remarque : Les vers à soie de toutes les variantes avaient des symptômes faibles de grasserie.

TABLEAU II - 1959

Vari- an- tes	Grou- pes	Vers à soie par grou- pes	Prépa- ration kg / 1000 m ²	Concentra- tion de la préparation	Alimentation des vers. Nombre de jours après saupoudrage	Vita- lité (%)	Richesse soyeuse (%)	Poids moyen d'un cocon sec (mg)	Effets visibles des préparations sur les vers à soie
1	3	200	3.0	5 % DDT	5	37.35	43.24	657	Forte perturbation nerveuse. Les vers se nour- rissent faiblement Perturbation nerveuse moins forte. Les vers se nourrissent mieux Perturbations faibles aux débuts. Les vers ne se nourrissent pas mais ensuite mangent norma- lement
2	3	200	1.5	"	5	67.15	43.59	688	
3	3	200	3.0	12 % Hexachl.	5	94.70	44.31	652	
4	3	200	1.5	"	5	91.90	44.82	640	" "
5	3	200	3.0	5 % DDT	10	92.43	45.05	799	
6	3	200	1.5	"	10	96.00	44.39	704	
7	3	200	3.0	12 % Hexachl.	10	92.85	43.80	715	
8	3	200	1.5	"	10	95.15	44.46	712	
9	3	200	3.0	5 % DDT	10	99.00	43.94	723	
10	3	200	3.0	12 % Hexachl.	10	98.50	43.38	819	
11	3	200			-	94.00	43.62	797	Les vers à soie se nourrissent normalement, sans perturbation " " " " " "

IIème CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960

DISEASES AFFECTING THE INDIAN SILKWORM RACES.

By Mr A. T. JANAKIRAMAN (India) (*).

HISTORICAL ACCOUNT.

Though Sericulture Industry has been in existence in India since before beginning of the Christian era there is no mention in earlier reports about the different diseases prevailing in the sericultural tracts of India. The fact that attempts were made to introduce foreign races between the years 1710 to 1833 led to the inference that indigenous races were not proving successful. It may be seen in the report of the Resident of Jungeypore, Bengal, in 1796, who was considered an authority on silk at the time, there was degeneration of silkworm races. He concluded that "Improper management of worms, improper food and the method of conducting the silk trade, may have been responsible for this degeneration. He also states that "Barapoli", indigenous race of Bengal had become "extremely precarious and uncertain".

During this period, a disease which was described as a sort of "atrophy" was reported in Mysore also. Disease was reported to be rampant in India between the years 1850 and 1870 when it was reported to be present in Europe. In 1836 at a Conference held in Calcutta on Sericulture, N.G. Mukerji and Wood Mason were requested to investigate the problems of disease in silkworms in India. Their investigations proved that the silkworm disease found in Bengal was identical with that found in Europe. After the return of N. G. Mukerji from Europe, in 1838, nurseries were started for the production of disease free silkworm seed. But the methods of production of seed did not improve and the failure of crops continued. It is interesting to see the report of Lister (1860) who attempted to rear silkworm on a large scale first in Punjab and later at Dehra Dun.

After initial failures, he could succeed in rearing good crops but failures occurred again. He attributed the disease "to the ignorance,

(*) Mr A. T. JANAKIRAMAN, Secretary, Central Silk Board, Meghdoot, 95-B Marine Drive, Bombay-2 (India).

neglect, dirt and unsuitable rearing houses" and recommended "sound seed, air, generous spacing and general cleanliness, regulated feeding and suitable rearing houses as certain means of securing successful crops". He has not mentioned of any causative organisms responsible for the diseases.

The diseases broke out in an epidemic form in other parts of India like Mysore and Madras, during 1890-1900. Attempts were, however, made to encourage sericulture but on account of the diseases there was no progress. By 1920, the Government of Mysore organized a Department of sericulture which secured the services of an Italian and later a Japanese expert for the development of sericulture in the State.

Afterwards, Professor Maxwell-Lefroy completed this investigations and laid much stress on the diseases and a factor responsible for the decline of the silk industry. He also suggested that the study of silkworms was to be taken up by the Imperial Agricultural Bacteriologist and in 1919, Hutchinson and later Pringle Jameson were entrusted with this work. Both the scientists worked on the life cycle of "Nosema bombycis", the life history of the parasite and the mode of infection of the spores inside the body of the worm and concluded that one of the diseases which cause failure to silkworm crops is Pebrine caused by Nosema bombycis as identified by Louis Pasteur.

PREVAILING SILKWORM DISEASES.

Common diseases found in the different sericultural States in India are Pebrine, Flacherie, Grasserie and Muscardine. Annually about 30 to 40 per cent of loss in the yield can be attributed to these diseases. C. C. Gosh reports the occurrence of diseases, "Gattine and "Court" which were infecting silkworms in Bengal. A brief account of the prevalence of different diseases is given below :

1. PEBRINE.

This disease was not known in India till 1895 but it was surmised that that disease must have existed in India during the period 1850-1870, since both Europe and Far East were having this epidemic. N. G. Mukerji has named this disease as "Mathakat" which means pale colour in Bengali. Maxwell-Lefroy reported in 1916 that pebrine disease broke out in India during 1895, especially in Bengal in a very virulent form. The silk industry which was flourishing well in Bengal declined due to spread of this disease. Production of raw silk which was nearly 1.6 million lbs. per annum during 1866-1870, came down to 2 million lbs. During 1937, (Maxwell-Lefroy). Hutchinson (1916) a bacteriologist in the Government of India who has reported on pebrine disease in India says the disease showed its appearance only towards the close of the last century in India.

Profesor Mukerji (1909) of Bengal who was deputed to Europe to study sericulture and improve the industry in Bengal could not make much headway as all the nurseries organised for the production of silkworm seed failed due to pebrine disease. (In other parts of India like Mysore and Madras, the disease broke out in an epidemic form in the years 1890 to 1900). Later due to better organisation, seed cocoons were produced by both Government nurseries and Government controlled agencies. The work of study of the life cycle of pebrine parasite was entrusted to Raichoudhury and Dasgupta (1946).

They report that "Chotopoli" and "Garopoli" worms reared in Birbhum and the neighbouring district of Bengal were more resistant to pebrine infection than other races. The affected worms had been found to grow normally and might even spin good cocoons. But with sudden change of climatic conditions, the disaster started and all the worms died within a day or two. In their opinion, partial immunity of the host to place which was closely related with humidity and temperature was responsible for the attack. By the frequent and careful inspection, the diseased worms must be picked up and rejected. Moths should be examined after oviposition. If pebrine spore is found the whole batch of eggs laid by the moth is destroyed. In other States also prevalence of this disease was reported. Rearing in villages were affected continuously with this disease.

Even after the introduction of Pasteur's system of examination of moths, the disease was prevalent because of the fact that the sericulturists did not leave their old irrational habits of rearing and handling of worms. This affected not only multivoltine races but bi-voltines and univoltines also. In Kashmir, where only univoltine races are reared, the disease is not eliminated completely even though healthy silkworm seeds of F1 races—both imported and prepared locally—are distributed. This may be attributed to want of proper control measures.

In Mysore and Madras, seed supply was properly organised in 1925-30 and even though healthy silkworm eggs were being distributed following the Pasteur's system of moth examination, disease was prevalent in an epidemic form in the years 1925 to 1930. In order to investigate and educate the village rearers, the means of avoiding this disease due to contamination, Government of India sanctioned a scheme for investigating into the contaminative aspect i.e. "Incidence of contamination of pebrine disease, effect of ventilation, environment and other cognate matters under village rearing condition".

The scheme was sanctioned in the year 1935 and investigation commenced in the village of Kalleel during 1936-37. Different experiments were conducted to find out the various methods by which pebrine disease is carried to healthy worms and came to the conclusion that the disease is highly contaminative under village rearing conditions and by taking proper preventive measures the disease could be brought under control.

In Mysore, in 1940 and 1947 the disease started as a mild epidemic in a large seed campaign area. This started in a densely populated group of villages. The source of infection was traced to a village about 15 miles from this group of villages where the rearers brought the mountages. These mountages were responsible for the infestation. By conducting a mass disinfection and persuading the rearers to use only examined seeds, the disease was controlled.

The prevalence of pebrine disease in village is more due to contamination due to the village rearing conditions even though healthy disease-free seeds are supplied. The usual symptoms of the pebrine disease are seen in the multivoltine areas but the occurrence of the black spots on the larva is very rare as this feature is reported to be common in uni and bivoltines reared in European countries.

Due to the proper organisation of seeds areas for the supply of disease-free seed cocoons, microscopic examination of individual moths, proper disinfection, education of sericultural hygiene, now pebrine disease has been controlled to a great extent, and occurrence of pebrine is very rare in the multivoltine areas of South India and West Bengal.

2. FLACHERIE.

Flacherie is known to be a common disease among silkworms, but it is only during 1850-75 after the investigation of Louis Pasteur the disease was identified as different form that of pebrine. This disease is called "Kalshira" in Bengal and "Sappe" or "Kenchu" in Mysore in local language. This disease causes more havoc to silkworm crops than pebrine during certain seasons of the year especially in the multivoltine areas. N. G. Mukerji states that among the several ill-defined diseases prevailing in Bengal during the latter part of the 19th century, flacherie must also be one.

Disease symptoms detected.

The diseased worms are recognized by the following symptoms. The worm loses its appetite and becomes sluggish in movement, look rather sickly losing the natural glossy and healthy appearance. It some times shakes the front part of its body as if in great distress, the dorsal blood vessel pulsating rapidly and irregularly. The pellets of excreta become soft and stick to one another. During moultings, the skin may not be shed properly but pieces of them may remain encircling the body with the advancement of the diseases, the worm becomes sluggish and vomits a brownish liquid. The faeces become soft, almost liquid and soil the silkworm bed. Finally the worm becomes motionless, its body becomes soft and discoloured and black, at first in the middle, then spreading all over the body. Putrefaction then sets in.

Pringle Jameson (1920) conducted a number of experiments to verify the different views of workers in Japan and Europe on Pathology of Flacherie disease in the multivoltine worms in India. His conclusions were that the growth of the Bacteria followed upon a series of digestive dis-

turbances induced by unsuitable leaves fed to silkworms. Associated with this disease, are three species of bacillus and five species of micrococcus. Pringle Jameson listed these bacillus and micrococcus as follows :

Bacillus A :	Probably	<u>Bacillus megatorum</u>	<u>Bombycis</u>
" B :	"	"	" <u>Ramosus</u> (Mucoides)
" C :	"	"	" <u>Celli</u>
Micrococcus A :	Probably	<u>Streptococcus</u>	
" B :	"	"	" <u>Bombycis</u>
" C :	Not identified		
" D :	Probably	<u>Micrococcus lutens</u>	
" E :	Not identified		

It is found to be not highly contagious or one associated with particular organism.

(Attempts made by A. P. Jameson to induce flacherie artificially on the lines of Sawamura's experiments (1902-1903) have indicated that high temperature and high humidity are likely to induce flacherie, but the experiments are not conclusive. Healthy caterpillars give a reaction of PH = 9.8. The gut of a worm in a hot moist chamber gives a PH = 8.4 to 8.6. This is a clear indication that the damage is being caused by unfavourable environment. Probably the growth of the bacteria follows and intensifies. It will be incorrect to state that the bacteria which may be present at this time is responsible for the onset of flacherie. Pringle Jameson found that the less alkaline nature of the gut was brought about by high temperature.

Other causes which may give rise to flacherie are coarse leaf, leaf not suited to the age of the worm and overcrowding of worms. Attempts made to bring about flacherie by any of these means were not attended with success. Leaves soaked in 10 per cent hydrochloric acid were fed to worms to determine if the highly alkaline gut of the caterpillar were made acidic, flacherie, would result. Only on one occasion all the worms died of flacherie.

Cultures made from the guts of such worms gave an abundant growth of Bacillus A. Five per cent ammonium hydrate gave two cases of flacherie while 10 per cent did not yield any result at all, but cultures made from the guts revealed numerous colonies of Micrococcus A and a few Bacillus A. In spite of hydrochloric acid, the PH ion of the gut remained 9.8 as in the normal worms indicating that the gut juice had obviously neutralised the acid completely. On the contrary, worms which exhibited symptoms of disease gave a PH of 2.6. Recent investigations of N. N. Roy, Agri-biochemist, of actual outbreaks of flacherie in Bengal also have shown that it is intimately connected with food. He has invariably found that the leaves in such cases had unbalanced constituents.

In one case it was excess of iron. The rearers in Bengal ascribe occasional occurrence of this disease to what they call "Bishalpata" i.e. "Poison in leaf". This condition occurs in the rainy season, when leaves

are affected by a rust. Roy associated this disease with deficiency of potash, low protein and sugar contents in the leaves due to deficiency of potash in the soil. Another "Nishalpata" condition arises soon after, pruning in Sept.-October, the fresh shoots of bush mulberry experience a shower of rain.

Drought followed by light showers, heavy showers after long spell of drought, or complete absence of rain, do not bring in these diseases. Light showers sometimes have been observed by Roy to upset physiological balance of nitrogen, phosphate and potash content of the soil causing poverty of soluble sugar and potash in mulberry leaves grown on it. He advises the increase of potash contents of the soil by adding the partially decomposed straw to it.

In Mysore, two types of flacherie are met with. In one type of flacherie, the skin of the worm is reddish brown in colour and this appears frequently during the hot humid months of the year namely April and May. In the other type, of the skin of the worms becomes pale and it appears during the rainy months of the year viz., November and December. These worms pass stringed faeces and this type of flacherie is a more virulent and infectious type.

Control measures.

It is felt that this disease can only be avoided but cannot be cured. Common precautions taken are :

1. Egg are selected from healthy stock.
2. Perfect hygienic conditions for rearing.
3. Proper quality of mulberry suited to different stages preferably of the same variety throughout the rearing.
4. Maintenance of proper temperature and humidity condition suited to different stages.
5. Proper spacing during rearing.
6. Cleaning of silkworm beds for paddy husk or lime.

3. GATTINE.

This is a kind of flacherie mostly prevalent in Bengal. The characteristic of this disease is that the anterior part of the silkworm becomes almost translucent and the worms take little or no food. Sometimes they vomit a colourless liquid. Worms of younger stages are prone to this disease. The digestive organs in the thorax and the forepart of the abdomen do not contain any food particles but gastric juice only. The worm, therefore, appears yellow limpid and transparent.

The disease is believed to be caused mostly by streptococcus bombycis, a round coccus slightly acid grampositive and 0.9 in diameter. It divides in single direction forming long or short chain. The chains are not present in liquid medium (Dasgupta).

Subsequently, it was proved that the primary cause of gattine is an ultravirus analogous to that of grasserie and the second one is Streptococcus bombycis. The intestinal contents of the gattinised worms lose all virulence when passed through porcelain filter. When infected with the ultravirus the PH remains unaltered as in normal worms but it increases afterwards at the time of Streptococcus infection (Dasgupta).

Gattine, therefore, is the result of double infection - one caused by ultravirus and the other Streptococcus bombycis. This disease is known in Bengali "Sulpha", "Hansa" or "Tatka". Shri C. C. Ghosh compares this to the "Lucettes" or "clanettes" of France.

4. COURT.

C. C. Ghosh describes another disease "Court" which is called "lali", "Rangi" and "Kurkutte" in Bengal. This disease is characterized by the pupa formed with cocoon formation and the pupa itself is much shorter than the worms. Shri N. N. Roy, Agri-biochemist, investigated this disease which occurred in Malda in 1940 (Feb.) which is published in the report of second All India Sericultural Conference (page 69) under the caption: "An instance of under development of worm due to certain elements in the food". In 1899, Shri N. G. Mukerji recorded this disease occurring in February-March owing to the leaf at the season being "wanting in nutrient properties" but stated that "when any considerable loss takes place from this cause it should be put down to latent pebrine".

Roy found that the worms were apparently healthy and free from any bacterial or protozoal diseases but did not produce silk. He found that the worms were not fully developed as far as growth was concerned in a state attained in the fourth age of normal worms of the same race. He kept under observation the plot of mulberry from which the worms have been fed.

A month later, the leaves from a part of the plot left, helped the worms to develop normally. At the time, when the leaves proved deficient, they had a high protein content, very low phosphate and potash contents. The soil contained a large percentage of nitrate-nitrogen due to the manure used and this coupled with deficiency of phosphates and helped by sudden rainfall led to charge absorption of nitrate-nitrogen by the leaves and insufficient formation of sugar in them. The leaves being immature and abnormally deficient in sugar did not provide sufficient nutrition to the worms (C. C. Ghosh, 1946).

5. MUSCARDINE.

This is called locally "chunakati" in Bengal, and "sunnakaddi" in Mysore, both referring to the white chalky appearance of the body of the worm. Dasgupta compares this disease to the disease named by Italians as "malded sene" and then "calcine".

The disease is not reported to be of common occurrence in India. Attack of muscardine is reported to have occurred consecutively for three years in Kashmir during 1930. Fumigation of the rearing houses was resorted to with sulphur and small quantities of sulphur were kept burning in the rearing house. The cause of this disease is believed to be high humidity. The disease appears occasionally in September-October and November-December crops in Bengal but is negligible in comparison with other diseases.

In Kashmir and in the hill stations of Bengal, rearings are often affected by muscardine in the rainy seasons. The loss of crops due to muscardine in the States of Mysore and Madras is not much. C. C. Ghosh reports however that this disease had been considered as a "Terrible scourge" by the silkworm rearers in Bengal. With liberal use of bleaching powder solution to wash rearing houses and appliances and by conservation of rearing house refuse properly since 1935, the disease has been completely brought under control in Bengal.

Symptoms of the disease.

Worms affected with this disease become sluggish and the beating of the dorsal vessel is faster than normal. The spores appear first around the spiracles usually and later on spread all over the body. The body of the worms becomes limp, elasticity is lost and the worm ceases to move. Soon the worm dies. Within a few hours of its death, the body of the worm becomes rigid and is usually covered with a fine efflorescence. The appearance of the white spores is not seen, if the humidity is very slow.

Worms affected with this disease just before mounting, may spin cocoons but there will be no emergence of moths. Microscopic examination is not necessary for diagnosing this disease as the spores of the dead animal are visible and are characteristic. The colour of the infected worm will be at first pink and after its death, appears like a piece of chalk being covered with a white felt-like material without decomposition.

Dasgupta reports that two species of a parasitic fungus are responsible for this disease "Botrytis bassiana" and "Botrytis cinella". The disease is transmitted by globular in shape, smaller in size when young and have less refractive index than pebrine spores. The spores remain alive for very long periods extending upto 3 years under favourable conditions. The spores germinate on the outer surface of the body of worm under suitable conditions of temperature and humidity and each spore pushes out a delicate filament which penetrates into the body of the worm through the spiracles.

The growth of this filament is very rapid and forms branching "mycelium". This "mycelium" ramifies all through the body of the worm and draws its nourishment from the fat body of the larva. The filament in turn produces "conidia" or knob like swellings which later on gives rise to fresh filaments. Thus the body of the worm is covered in all parts with the ramifications of the fungus. Blood turns acidic, becomes scanty and the death

of the worm follows. After the death of the worm the fungus penetrates through the skin and thus the skin is covered with a layer of white filament which carried the spores. Shortly after the death of the worm, a very characteristic production of Ammonium Magnesium Oxalate crystals outside the body of the worm is seen. Muscardine disease is found commonly in other insects especially in caterpillars.

In India it takes only 10 days in cold weather and 4 days in hot weather to complete the life cycle.

Only the spores are capable of producing this infection. The transmission of the disease either through cutaneous or digestive way depends on certain external conditions. The moths, like the worms, are also affected with this disease but cannot pass on to the eggs.

Control measures.

Once the fungus attacks the worms it is impossible to cure the worms of the disease. Hence preventive measures and destruction of the germs should be followed. When the disease is detected in a batch of rearing, the affected worms should be picked up and burnt. Litter is to be protected. Disinfection of the rearing house and appliances with 2 to 5 % formaline is recommended. Successive burnings of sulphur, good ventilation, adequate lighting and dry bodies should be observed when the disease is noticed for the first time.

GRASSERIE.

The presence of this disease is reported from a long time generally in the worms of fourth and fifth ages. This is known as "Halu Hala" in Mysore State and "Rasa" in Bengal.

Symptoms.

The diseased worms exhibit swelling at the segments, the skin gets stretched, begins to shine, finally bursts and a fluid escapes out of the breaks. The diseased worms in the final stages of attack show most pronounced swellings at the segments giving the worm the appearance of being noded. It becomes restless, its colour changes to light yellow and crawls about on the rearing tray. If the disease occurs just before moulting, which is the period at which it is most likely to occur in the earlier stages, the worm does not go into moult earlier but crawls aimlessly about. A ripe worm attacked with grasserie may waste its silk or it may spin a flimsy cocoon and die before pupa formation. Some may even live to pupa formation and then die. The disease occurs usually in the foreign races of uni and bivoltines and to a lesser degree in the case of local races.

Like other diseases, grasserie is also an old disease affecting silkworms. The earlier workers believed that this is caused by a protozoan like pebrine. Pringle Jameson (1919) states this disease is due to certain metabolic disturbances in the body of silkworms. Glazer (1934) is of the opinion that the disease is due to a virus characterized by the

formation of polyhedral bodies. Grasserie virus are found in large quantities in the body fluid of the affected silkworms.

The nucleus is first affected, then the cytoplasm forming the polyhedral bodies in the affected silkworms. Hypodermic injection of the polyhedral bodies to healthy silkworms brought the infection to the latter whereas oral administration seldom affected the healthy worms. The polyhedral bodies affect the tissues of silkworms containing nucleus and cytoplasm but not the gland cells. N. N. Roy, Agri-biochemist, found a substance in the tender leaves of mulberry. In some cases, this substance even in minute doses is known to act as virulent poison and which he founds to be associated with polyhedral crystalloids.

The polyhedral bodies

- 1) measure 3 to 5
- 2) 1.8 to 2.4 when silkworms moult
- 3) roundish in the beginning and later change to hexagonal shape
- 4) white in colour
- 5) specific gravity 1.24 to 1.26
- 6) refractive index 1.5362
- 7) soluble in oxalic acid and lactic acid
- 8) insoluble in water, alcohol and acetone
- 9) when treated with alkaloid, it loses its properties and swells
- 10) dilute picric acid stains the polyhedral bodies and prominently seen under the microscope. It is an accepted theory that grasserie is caused by a virus but the mechanism of its infection is still to be discovered. Feeding worms with leaves not suited to the age, atmospheric, temperature variations are found to be responsible for this disease.

Control measures.

There is no direct cause for this disease. Rearing worms under perfectly hygienic conditions, avoiding unsuitable leaves, cleaning silkworm beds with lime powder proper ventilation providing proper spacing, picking of affected worms and throwing them away are some of the precautionary measures followed. Efficient disinfection to kill the virus also helps in preventing the disease. In the case of bush mulberry grown in Bengal, Mysore and Madras the practice of breaking the terminal portions of plants from which leaves are intended to be fed to growing worms and thus allowing the leaves to mature without further growth of shoot is practically found to be effective. Leaves of trees and high bush are for the same reason observed to enable the worm to resist the disease.

The problem of disease of silkworms in India is as important as in other sericultural countries of the world. Pebrine disease can be controlled even under village rearing conditions by the issue of healthy examined silkworm seeds, observance of sericulture hygiene, both in the uni and multivoltine areas but flacherie disease is still a problem disease especially in the multivoltine areas due to various cause. The entire silkworm crop is lost due to certain abnormal conditions. Resear-

ches on the improvement of silkworm races suited to different areas resistant to flacherie are of fundamental importance to have better yield of silkworm crops.

MALADIES AFFECTANT LES VERS À SOIE
EN INDE.

Résumé.

Il apparaît que 30 à 40 % des pertes subies dans les élevages sont dues à la présence de pébrine, flacherie, grasserie ou muscardine.

Après un rappel historique concernant ces maladies, l'auteur en analyse les symptômes et décrit les moyens de lutte en usage en Inde.

Troisième Partie.

S U P P L E M E N T.

CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE:
MURCIE (Espagne) - Avril 1960.

DISEASES OF INDIAN MULBERRY.

By Mr A. T. JANAKIRAMAN (India) (*).

According to the nature of the causal agent, three groups of plant maladies in mulberry may be recognized. They are parasitic diseases, virus diseases and non-parasitic diseases caused by the deficiency of mineral elements in the soil.

C. C. Ghosh (1944) described the diseases and pests of mulberry as observed and reported from different places in India. He has given a short account of the common diseases of mulberry. Mulberry is susceptible to various diseases. The degree of resistance to these diseases depends upon the variety of mulberry and also on the soil and climatic conditions.

The following are the common diseases found in India :

1. Mildew disease on leaves.
2. Leaf spot on leaf.
3. Root rot (Violet).
4. Wound parasite on stem.
5. Gummosis on stem.
6. Cankers on stem.

Diseases caused by animals and insects are :

1. Scale insect on stem.
2. Longicorn beetle borers in stem.
3. Caterpillar borer on stem.
4. Hairless caterpillar on leaves.
5. Hairy caterpillars on leaves.
6. Weevils on leaves.
7. White grubs on roots of seedlings and young plants.
8. Termites on roots.

(*) Mr A. T. JANAKIRAMAN, Secretary, Central Silk Board, Meghdoot, 95- B Marine Drive, Bombay-2 (India).

9. Hole rats on roots of fairly grown up plants.
10. Tukra disease.

POWDERY MILDEW ON MULBERRY LEAF.

This one of the most important diseases of mulberry causing much damage to the leaves both on the hills and in plains. It is caused by a fungus Phyllactinea corylea which belongs to the order Erysiphales of the series Pyrenomycetes of the Class Ascomycetes. This disease occurs both in rainy and dry conditions usually in the months of July to September in Mysore regions. The fungus is an obligate parasite which infects only the under surface of the leaves. The first symptom is the occurrence of white or grey white patches on the ventral side of the leaf. These patches later turn black through brown. Generally mature leaves are affected with the fungus. Affected leaves do not wither immediately but are less nutritive and apt to dry. The greyish part on the affected leaf shows the existence of the mycelium and conidia of the fungus. The mycelium spreads on the surface of the leaves like a spider web. Most of the hyphae are superficial but these do not develop haustoria. The fungus obtains nourishment by special hyphal branches which enter the stomata, come in contact with mesophyll cells and send haustoria into them.

A few days after the fungus infects the host its somatic hyphae produce great number of long hyaline, erect conidiophores which begin cutting off conidia at their tips one below the other. The conidia fall off individually as they are formed. Conidia are one-celled, oval or rectangular with rounded corners. Conidia are carried away by means of wind, germinate and infect the mesophyll tissue on other leaves through stomata. Since conidia are capable of germinating as soon as they mature, they spread from plant to plant and from field to field and the disease soon reaches the magnitude of an epiphytotic. In late summer when conidial production slows down, young cleistothecia begin to make their appearance on the white mycelium cleistothecial appendages are rigid, spear like, with a bulbous base and pointed tip. Several asci with two ascospores are formed.

Prevention :

1. Spraying of solutions prepared at the rate of half an ounce of potassa sulphurata in a gallon of cold water is effective in killing the spores. The spray is done only on the under surface of the leaves.
2. Introducing disease resistant varieties.
3. Eradicating the alternate host plants in the vicinity.

LEAF SPOT.

It is a disease caused by a member of the class fungi imperfecti. It attacks chiefly young leaves and become covered with spots of pale brown colour at the centre surrounded by a dark reddish brown band. This disease

se is more prevalent in dry conditions. Especially plants in nurseries are affected by this fungus. The filaments of the fungus penetrate the inner tissues of the leaf but are limited in growth and affect an area usually not exceeding a quarter of an inch in diameter. The transverse section of the infected leaf shows brown pustules with number of conidia. The detailed life history is not known.

ROOT ROT (VIOLET).

So far only one fungus has been recorded from Bengal causing root rot of bush mulberry. However, the details of nature of infection are not known. By observing the parts near infected roots, velvet membrane like film covering the root is seen. Bark of the root turns dark brown and the area between the bark and the woody part becomes completely putrified. Sometimes reddish purple semi-spherical bodies are seen on the surface of a wholly rotten root. The fungus causing the rot may be a member of the class Basidiomycetes.

Prevention.

- (1) This disease is prevented by selecting uninfected saplings.
- (2) Disinfection of seedlings, digging out of the affected trees and disinfection of the area.

Wound parasite. *Coryneum mori* a fungus parasite affects wood in Kashmir. It is a fungi imperfecti affecting the cut end of the branches of trees and completely killing the infected area. The mycelium of the fungus is intercellular and when mature it produces several conidia which are liberated by the rupture of the bark.

Prevention.

- (1) It is prevented by removal of the dead wood from the garden as the fungus also attacks dead wood.
- (2) Proper pruning of branches without leaving any jagged branches is necessary.

GUMMOSIS IN MULBERRY.

It is found in mulberry that the production of a clear amber coloured exudate on the surface of certain portions of the affected parts of the plant which later sets into a solid mass insoluble in water. The entire stem becomes coloured with a black or grey coloured waxy substance on the solidification of the exudate. The details of the causative organism are not known.

CANKERS IN MULBERRY.

On the stems of mulberry certain wounds are formed which are often of a spreading nature. They show deep cuts called cankers. The pathogene attacks the bark of plants causing the death of tissue. Cankers are surrounded by a raised tumour like margin. The details of the pathogene are not fully known.

Several lichens of fruticose and foliose are found growing on the bark of the stem of the trees, thereby covering all the lenticels which affect the respiration rate.

Loranthus, an angiospermous partial stem parasite, is also found growing on mulberry trees absorbing all the nutrient contents of the stem. These are removed by separating the connection between the parasite and the host.

SCALE INSECT ON STEM.

Scale insects occur on stem and branches and also as small scales in the bark. It is caused by an insect which belongs to the class Coccidae. Usually this disease is more prevalent in hilly regions especially on trees and medium size trees. But very rarely they are found on bushes. They stock the cell sap and kill the plant. Since all the surface area is covered with scales, the lenticels are completely hidden, as such the respiration rate of the cells of the stem also is considerably lowered. Tissues will be spoiled due to non-interchange of gasses from the interior to the exterior. This is controlled by smearing or spraying diesel oil, soap solution or rosin compounds.

TUKRA DISEASE.

This is one of the serious diseases of mulberry which is adversely affecting the Silk Industry in Bengal. The symptoms of this disease are in the form of severe curling and crinkling of the leaves of the apical shoots and the swelling and twisting of the stem, especially the apical internodes. There is considerable controversy regarding the nature of the causative organism responsible for the disease. At one time it was thought that an insect *Phenacoccus hirsutus* was the cause for the disease. This white mealy bug dwells in the knots of the leaf. Later investigations made by the Bengal Sericultural Department with the help of late N. N. Roy, Agricultural Biochemist, revealed an association of this disease with deficiency of phosphates in the soil. The insect is not present when crumpling commences and appears when crumpling is made.

Reports from Sericultural Research Institute, Berhampore (1959) show that insect in its various stages has been found in the folds and knots of the leaf. When these insects are allowed to feed on healthy leaves they show symptoms. The damage is caused mostly by the nymphs and adult females which usually, congregate in large number and suck up the sap of the stem, leaf and petiole by thrusting their long and filamentous stylet fascicle under the deeper cuticle layer. The pest chooses more the apical region than the other parts of the host plant. Among the various insecticides tried, Nicotine sulphate is found to be effective.

LONGICORN BEETLE BORERS IN STEM.

A legless white fat grub borer tunnels inside the stem and branches and throws out wood dust through holes here and there on the sides of the affected stem or branch. The infected regions, either stems or branches may be converted into hollow tubes. Physiological activities of the plant are affected by this borer. This grub takes several months to grow and feeds all the time by corroding the wood and forming tunnels. An allied grub borer just under the bark causes extensive tunnels filled with wood dust and grass. The grub ultimately turns into a beetle with long antennae.

CATERPILLAR BORER ON STEM.

This is caused by a species of arbelia which makes a hole in the stem and lives inside. This occurs only on tree mulberry. It nibbles the surface of the bark round the hole. Under cover of a webbing in which the pellets of its excreta are interwoven and held. Damage caused actually by this is not much. It is prevented by removing the webbings. When it grows full it transforms into a moth which lays eggs from which caterpillars hatch.

HAIRLESS CATERPILLAR ON LEAVES.

It is caused by *Glyphodes phyloates*. These are slender, hairless and greenish yellow in colour. Occasionally occur on leaves and make holes in them. It turns into pupa in a fold on the leaf and finally into a moth which lays eggs from which caterpillars hatch. It is prevented easily by hand picking and destroying.

HAIRY CATERPILLARS ON LEAVES.

The hairy yellow coloured caterpillar (*Diaparsia obliqua*) has been found in large numbers on bush mulberry of which all the leaves were eaten by it. They hatch from eggs laid in clusters on the under surface of the leaves usually in several hundreds. They eat the green tissue of the leaf leaving the white membrane later they disperse and go on biting and feeding on leaves until they are fully grown. They descend to the ground and form cocoons in which pellets of earth and their own hairs are woven. They finally emerge as moths and lay eggs on the under surface of the leaf. The damage caused by this is appreciable and the practical remedy is to collect the leaves with eggs and clusters of young caterpillars and bury them under the ground.

WHITE GRUBS OR COCKCHAFER GRUBS (*LACHNOSTERNA* SP.).

These grubs are met with in cowdung heaps and in the soil among roots of grasses, cereals, vegetables etc. The eggs are laid by beetles which emerge from the earth in large number after the first heavy showers of rain, mate lay eggs in the soil. The grubs hatch from the eggs, feed on the humus and on any root system, after they pupate and become beetles.

The grubs may come into the field with farmyard manure applied to the field. Therefore, a thorough search is made before applying manure. If the infection is seen in seed beds the remedy is to rake the soil and pick them off.

WEEVILS (APION SP.) ON LEAVES.

The occurrence of this pest is rare and less injurious. It was reported from West Bengal, mulberry bushes were affected. A small black weevil with a long snout was observed at Sericultural Research Station, Berhampore. They generally puncture and spoil the leaves.

TERMITES (WHITE ANTS).

Newly planted grafts and cuttings especially on sandy soils are affected with this pest. They can be prevented by imparting smell of kerosene oil to the soil by watering it with solution of one pint of kerosene emulsion in a tin full of cold water.

Mole rat on roots : The mole rat has a peculiar attraction for mulberry roots which they eat underground killing off entire bushes and even fairly well grown medium trees. It is prevented by digging out and destroying rats as soon as mounds of earth are observed in the field. Mulberry plantation in the hills in South India are not free from this pest.

It may be stated that in general the several pests on mulberry found in India do not cause very heavy damage to plantation. The attack is sporadic and sometimes seasonal. Timely attention and proper cultural operations reduce the incidence to a great extent.

LES MALADIES AFFECTANT LES MURIERS EN INDE.

Résumé.

On distingue trois groupes de maladies du mûrier : les maladies dues aux parasites, celles dues aux virus et les maladies non parasitaires. Le degré de résistance du mûrier est fonction de la variété et des conditions écologiques. Les ravages causés par les maladies à virus, les fungi et les gommoses sont moins importants que ceux causés par les parasites du mûrier très nombreux aux Indes. L'auteur décrit les moyens de lutte utilisés en Inde.

11ème CONFERENCE TECHNIQUE SERICICOLE INTERNATIONALE
MURCIE (Espagne) - Avril 1960.

BASIC RESEARCHES TO ASSURE
THE COCOON PRODUCTION IN JAPAN (1).

By Mr Tadao YOKOYAMA (Japan) (*)

Sericulture has long been a labour intensive agriculture using large amount of labour. The recent agricultural labour situation in Japan, however, is very difficult to afford sufficient amount for sericulture and the cost of labour is rising steeply. In order to assure the cocoon production, it is necessary to find a labour economizing system in sericultural techniques, which necessarily involves mechanization of various steps in sericulture.

The mechanization of sericulture is practiced efficiently only in a comparatively large scale operation.

It must naturally be assumed that the cocoon crop is stabilized under the new and labour economizing techniques. For the proposed objective, it is necessary :

- 1) to breed stronger silkworm races more resistant to every assumed unfavourable conditions,
- 2) to avoid the ill-nutrition of the silkworms,
- 3) to avoid the infestation of the silkworms with various pathogenic factors.

The researches which are under practice in the Sericultural Experiment Station, Ministry of Agriculture and Forestry, Japan, with the objective to solve the above mentioned problems are as follows :

(*) Mr Tadao YOKOYAMA, Director, National Sericultural Experiment Station, Suginami-ku, Tokyo (Japan).

(1) Ce rapport a été déposé par M. le Professeur Tadao Yokoyama auprès de la Section I de l'Association Internationale de la Soie lors du VIIIème Congrès de cette association, tenu à Londres en Juin 1961.

1. MECHANIZATION OF SERICULTURE.

The mechanization of sericulture involves the mechanization of the mulberry culture, silkworm rearing as well as the disinfection of mulberry and silkworm.

The relative amount of labour necessary for various steps of cocoon production is shown in table 1. It is necessary to economize labour in all items involved in the cocoon production, but we put an especial weight to the study to decrease the labour by mechanization in the items which need a large amount of labour.

TABLE 1. RELATIVE AMOUNT OF LABOUR BY ITEMS NECESSARY FOR THE PRODUCTION OF COCOONS
(Investigation of the cost of production in cocoon, 1959, M.A.F.)

Items	100 kg hour/cocoons	%
Cultivation and manuring of mulberry	54.21	8.1
Ploughing and weeding	76.20	11.4
Insect and fungus control	1.12	0.2
Other items	27.68	4.1
Total	159.81	23.8
Mulberry leaf-collecting	164.18	24.4
Rearing of silkworms	190.09	29.2
Silkworm mounting	77.79	11.6
Cocoon collecting	42.60	6.3
Disinfection	9.72	1.4
Other items	22.13	3.3
Total	512.56	76.2
Grand Total	672.32	100.0

The mechanization of mulberry culture begins at the study of the distance between each mulberry tree convenient for the use of cultivating and other machines. Next comes the studies on the training, method and frequency of harvesting as well as the selection of appropriate mulberry varieties.

The machines which are to be used in the study are selected among the small or medium-sized ones usually used in general agriculture. The machines are to be reformed or improved to be adjusted for the use in various sides of mulberry culture: cultivation, manuring, weed-control, leaf-collection and leaf transportation.

As it is necessary to enlarge the unit area of every mulberry field to efficiently mechanize the mulberry cultivation, the development of the new mulberry field in a large unit and joint management of the mulberry field are recommended.

As the largest amount of labour in cocoon production is used in the silkworm rearing, it is desirable to mechanize the rearing procedures. The study on this problem, however, has just been begun and the results are expected in future.

The research projects are concerned with studies on the structure and material of the supposed mechanized rearing room and on mechanization of mulberry leaf collecting and feeding.

As for the mechanization of disinfection of mulberry or silkworm, it is necessary to consider that the disinfection must be practiced in a very short and appropriate period. The invention of an efficient machine, efficient reagents and establishment of efficient techniques must be studied.

2. STABILIZATION OF CROPS.

1) Breeding of resistant silkworm varieties.

In the silkworm breeding, the resistance of the silkworm to various unfavourable factors has always been considered as well as the quality and quantity of the silk substance produced by the silkworm. However, in future sericulture to be practiced under the labour-economizing techniques, the heaviest weight must be put on this characteristic among others in silkworm varieties.

In Japan every industrial silkworm race must be licenced by the Ministry of Agriculture and Forestry. The material for the judgement of licence is mainly supplied by the co-ordinate experiment of 18 experiment stations belonging to the central or local government or to the private company.

Recently they took into their co-ordinate experiment an unfavourable condition such as 28° C. in temperature and 90 % in relative humidity during the fifth stage of silkworm in order to screen out the less resistant races.

The fact which suggests the possibility of the selection of resistant races by means of γ -ray irradiation was recently found in this station.

2) Studies on the nutrition in the silkworm.

It has long been known that there is an intimate relation between the nutrition especially that in the younger stages of the silkworm and the mortality thereof. Recently another knowledge was added in this con-

nection that the induction of a certain virus disease in the silkworm was much influenced by the nutrition of the silkworm in the younger stages.

It is not yet completely known what is the necessary characteristics of the mulberry leaf to ensure the healthiness of the silkworm. In order to elucidate the concerning factors and to find the measures to enrich the leaf of less nutritive nature, a series of studies to rear the silkworms with artificial diet was carried out. As the results of efforts of Drs. T. Yoshida, T. Fukuda and T. Ito, they succeeded in rearing the silkworms from hatching to spinning cocoons exclusively with the artificial diet, an example of which composition is shown in table 2.

TABLE 2. COMPOSITION OF BASAL ARTIFICIAL DIET FOR SILKWORM. (Ito, 1960).

	dry wt. %
mulberry leaf powder	10
potato starch	15
sucrose	30
soy bean casein	24
soy bean oil	6
Wesson's salt mixture	1
Cellulose powder	14 (50)
	100

The studies have not been carried out long period, but, in the comparatively short period of study many interesting discoveries in the silkworm nutrition have been made, e.g., the importance of sterols and vitamin C and the effect of cellulose to accelerate the feeding and to improve the nutrition. The ration of cellulose was at first 14 % as shown in table 2, but increased afterwards to 30 % with remarkably good results.

The artificial diet-rearing of silkworm enables to rear the insect in aseptic condition, which will contribute very much to the pathological and other studies in silkworm.

Dr. T. Fukuda succeeded in rearing Eri-silkworm in large scale (5,000 worms) with artificial diet with the result that the silkworms made cocoons with the quality the same or even superior to those obtained by using the natural food leaf.

Among the factors hitherto known to influence the nutritive value of the mulberry leaf, such as temperature, solar radiation, soil condition and manure, the amount of organic compound in the soil of mulberry field is being studied in large scale. It was found that the amount of organic component in the sandy soil had very remarkable influence on the yield and quality of mulberry leaf.

The water content of the soil influences the growth of the mulberry tree and the water content of the leaf. When the soil moisture is so small as 10 %, the water content of leaf decreases by more than 3 %, consequently the growth of the silkworms which are fed with such leaves is retarded and the cocoons are small.

3) Studies on the silkworm disease.

Notorious silkworm diseases influencing the cocoon crops in Japan are as shown in table 3.

As for muscardine, there was found a very effective method of prevention. The flacherie, however, is so destructive that about 70 % of the damage in sericulture caused by disease is due to this disease.

However, the studies in this field are gradually progressing. They found that the flacherie disease is a compound one. There are included at least 2 ultra-virus diseases, cytoplasmic type virus disease and an infectious virus disease without producing polyhedral particles. The disinfection with usual reagents is found very effective to prevent the both diseases.

The occurrence of Bacillus thuringiensis in the main sericultural districts was recently found, and it can also be controlled by the perfect disinfection.

TABLE 3. SERICULTURAL DAMAGE BY VARIOUS DISEASES IN JAPAN.

	1956	1957	1958	1959	1960
Flacherie	76.0	65.9	73.0	67.0	75.1
Muscardine	11.6	21.6	14.3	17.3	10.3
Grasserie	10.0	8.7	8.9	3.0	9.6
Aspergillus disease	0.6	1.4	1.2	1.0	0.8
Kyoso-fly parasitism	0.0	0.0	0.1	0.1	0.0
Mite	0.4	0.4	0.8	1.6	2.0
Physiological disorder owing to mulberry	-	-	-	-	-
Tobacco intoxication	0.2	0.1	0.1	0.0	0.0
Intoxication of agricultural chemical	0.2	0.4	0.4	0.4	0.5
Others	0.6	1.3	1.2	4.4	1.7
Total	100.0	100.0	100.0	100.0	100.0

RECHERCHES ESSENTIELLES POUR ASSURER
LA PRODUCTION DE COCONS AU JAPON.

Résumé.

La conjoncture économique actuelle au Japon impose la mécanisation dans les différents stades de la Sériciculture mais elle n'est applicable qu'aux grands élevages.

La Station Nationale Séricicole Expérimentale de Tokio (Ministère de l'Agriculture et des Forêts) porte actuellement dans ce but ses recherches sur les problèmes suivants :

- 1) mécanisation de la sériciculture
- 2) stabilisation des récoltes
- 3) études des maladies du ver à soie.

1. La mécanisation de la sériciculture porte d'abord sur les postes où la main-d'œuvre est la plus nombreuse. La moriculture sera mécanisée par l'adaptation rationnelle des machines au travail demandé ; l'élevage par l'étude des matériels de magnanerie et de cueillette des feuilles et de distribution des repas. Enfin, on cherche aussi à mécaniser la désinfection.

2. La stabilisation des récoltes sera obtenue par l'élevage de variétés plus résistantes de vers à soie aux différents facteurs défavorables ainsi que par des études poussées sur la nutrition du ver à soie en recherchant grâce à une alimentation préparée les facteurs susceptibles d'influencer la valeur nutritive de la feuille de mûrier.

3. Etude des diverses maladies du ver à soie (dont la muscardine et la flacherie qui est la plus grave sous deux formes virales), des désinfectants et des techniques de désinfection.

N.D.L.R. - Le Secrétariat Général attire l'attention sur la très grande importance de cette note de M. le Professeur YOKOYAMA et remercie vivement ce dernier pour son importante contribution aux recherches pouvant assurer l'avenir de la production de la soie.

Directeur-Gérant : A. SCHENK * Dépôt Légal : 5ème Trimestre 1964.

Imp. G.S.I. ALES (Gard)