PARTHENOGENSIS

Parthenogenesis is the development of an egg without fertilization. (Gr.Parthenos=virgin; gensis=birth). The individuals formed by parthenogenesis are called parthenotes. Parthenogenesis may be of two types. They are natural parthenogenesis and artificial parthenogenesis.

1. NATURAL PARTHENOGENESIS

When parthenogenesis occur spontaneously, it is said to be natural parthenogenesis. Parthenogenesis is a regular natural phenomenon in a few groups of animals. Some animals reproduce exclusively by parthenogenesis.

In some other species, parthenogenesis alternates with sexual reproduction. Based on this, natural parthenogenesis is divided into two groups, namely **complete parthenogenesis** and **incomplete parthenogenesis.**

1) Complete Parthenogenesis

In certain animal parthenogenesis is the only method of reproduction. This type of parthenogenesis is called complete or **total** or **obligatory parthenogenesis**. Populations exhibiting total parthenogenesis consist entirely of females. There are no males. **E.g. Lacerta (lizard).**

1) Incomplete Parthenogenesis

In some animals parthenogenesis reproduction and sexual reproduction occur alternately. This is called **incomplete** or **cyclical parthenogenesis**.

Example

a. In gallflies, there is one parthenogenetic reproduction and one sexual reproduction per year (P,S,P,S, (P,S,.....).

b. In aphids, daphnids and rotifers one sexual reproduction occurs in summer after many parthenogenetic reproductions, (P,P,P,P,P,S,.....P,P,P,P,P,S.....P,).

Natural parthenogenesis is further classified into two types. They are haploid parthenogenesis or **arrhenotoky** and diploid parthenogenesis or **thelytoky**.

A. Haploid Parthenogenesis or Arrhenotoky

It is the development of a hyploid egg into a haploid animal. All the haploid individulas are **males**. Arrhenotoky occur in insects, rotifers and arachnids.

i. Haploid Parthenogenesis in insects:

In insects haploid parthenogenesis is exhibited by hymenoptera, **homoptera, colepters** and **thysanoptera**. In bees and wasps parthenogenetic eggs develop into males and fertilized eggs develop into females. Hence, the males and haploid and the females are diploid. The males are fertile. During spermtogenesis, the reproduction division is omitted.

Hence, the spermatogenesis contain the halploid number of chromosomes as the parent. The females contain diploid number. The eggs are formed as meiosis; Hence, they are haploid.

ii. Haploid parthenogenesis in arachnids:

In arachnida, arrhentoky is exhibited by ticks and mites, As in bees , here also the unfertilized eggs develop into males and

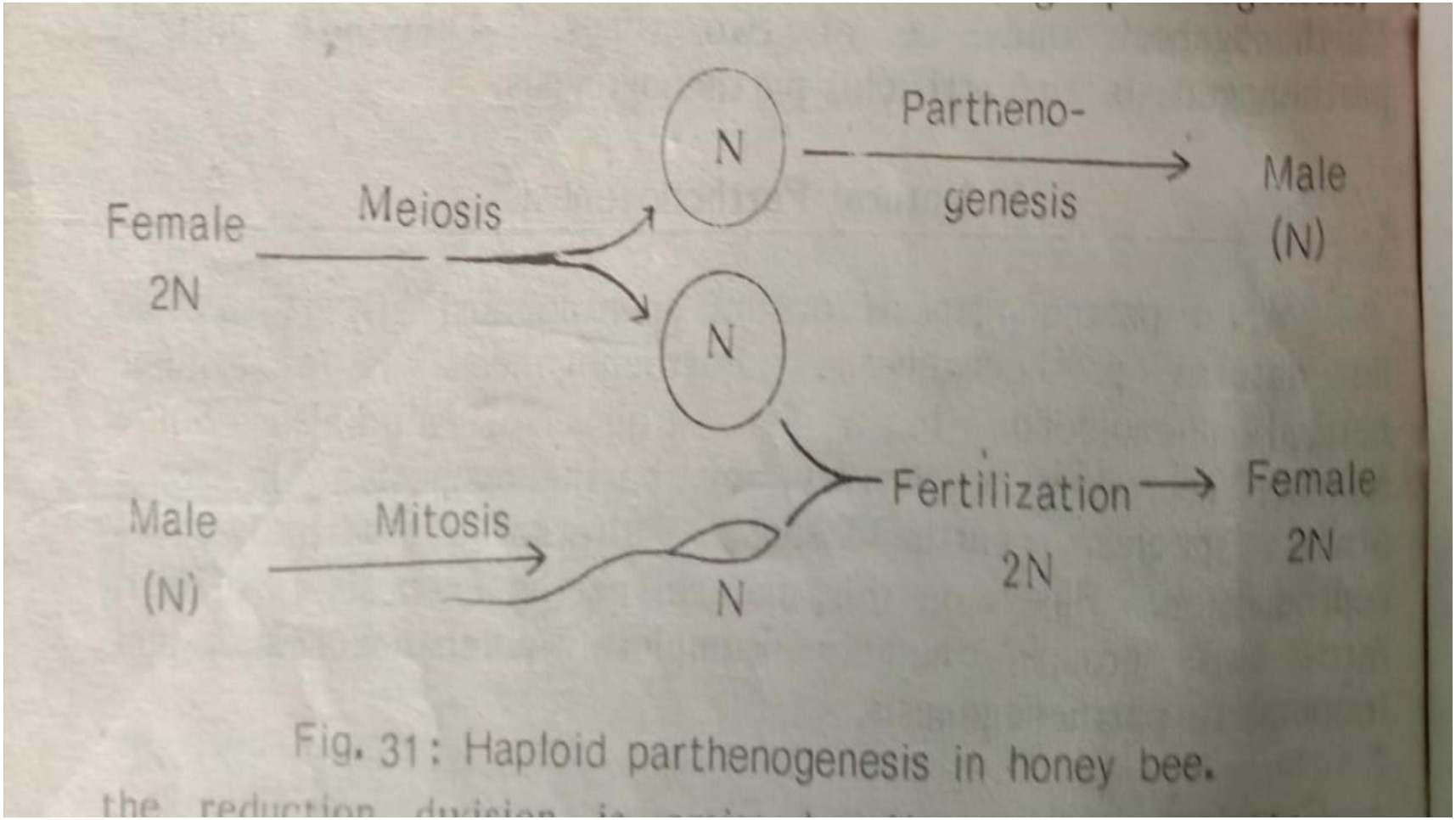

Fig. 31: Haploid parthenogenesis in honey bee.

fertilized eggs develop into females. Hence, the males are haploid and femlaes are diploid.

iii. Haploid Parthenogenesis in rotifers:

In rotifers, both haploid and diploid parthenogenesis occur. **Asplanchna amphora** exhibits haploid parthenogenesis. Here the males develop from haploid eggs. In **Bolelloidea** males are unknown and parthenogenesis is the only rule.

B. Diploid Parthenogenesis or Thelytoky

The development of a diploid egg into an embrya without fertilization is called **diploid parthenogenesis**. The diploid condition is maintained either by omitting the reduction division or by the fusion of one of polar bodies with the haploid egg. Based on this, thelytoky is classified into two types, namely **ameiotic thelytoky** and **meiotic thelytoky.**

1) Ameiotic Thelytoky:

In ameiotic thelytoky, meiosis is suppressesd. The egg is produced by simple mitosis. As a result the egg is diploid. It generally occurs in crustacea and insects.

1) Meiotic Thelytoky:

In meiotic thelytoky, meiosis occurs during oogenesis and the haploid eggs are produced. The diploid condition is achieved by the doubling of the chromosome. The doubling of the chromosome is called diplosis. Diplosis occurs in any one of the **two ways**, namely **restitution** and **autofertilization.**

a) **Restitution** : In this process the first maturation division is incomplete. The chromosomes move to the opposite poles. But the cytoplasm fails to divide. Now the cell contains chromosomes in quadruplicate .

The second maturation division occurs normally. This results in the production of two diploid cells. One cell is smaller and is called polar body. The other cell is large and it develops into the egg. This diploid egg develops into the embryo without fertilization **e.g. lepidopteran insects**.

b) **Autofertilization** : In this process, meiosis occurs normally during oogenesis. The haploid egg then becomes diploid by fusing with one of the polar bodies. This process called a**utofertilization**. In **Artemia salina** (brine shrimp) diplosis occurs by the fusion of egg with the second polar body.

Parthenogenesis in Vertebrates

Natural parthenogenesis is rare in vertebrates. A few parthenogenesis vertebrates occur in nature. They are as follows:

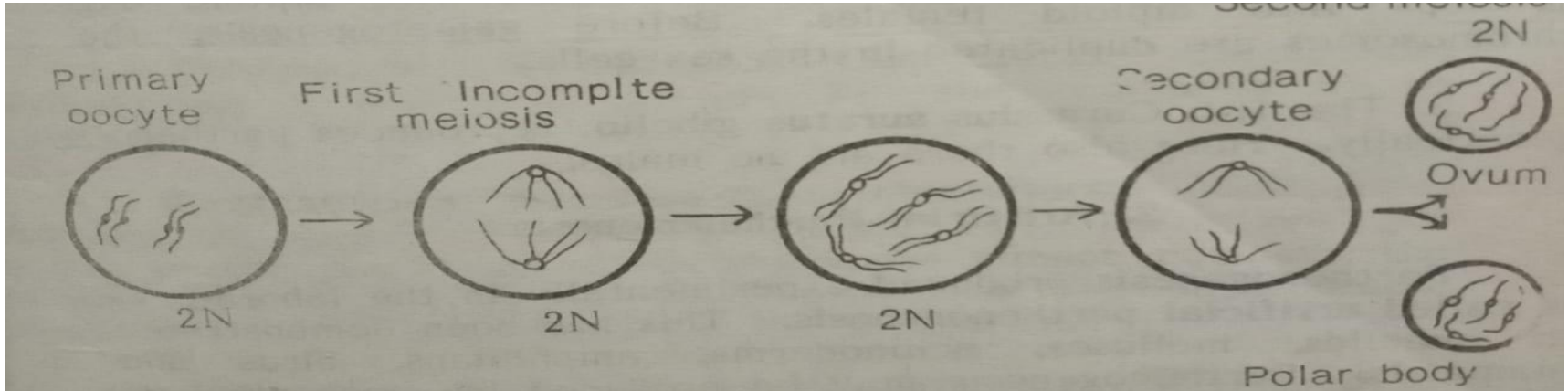

Fig. 32: Diploid parthenogenesis by restitution..

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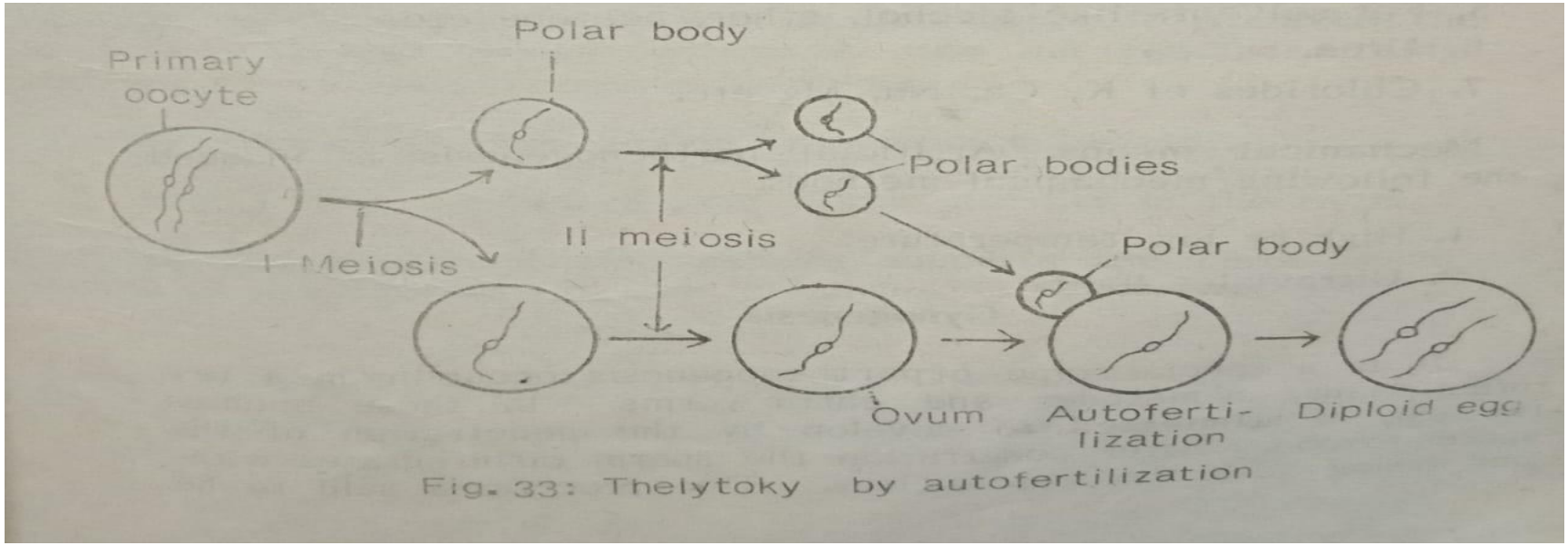

Fig. 33: Thelytoky by autofertilization

1. In the case of lizard **Lacerta saxicola armeniaca** there are no males. It produces diploid egg. The diploid egg develops into diploid females. Before gametogenesis, the chromosomes are duplicated in the sex cells.
2. The fish **Carassius auratus gibelio**, reproduces parthenogenetically. Here also there are no males.

2. ARTIFICIAL PARTHENOGENESIS

Parthenogenesis produced experimentally in the labortary is called **artificial parthenogenesis**. This has been demonstrated in annemids, mollusca, echinoderms, amphibians, birds and mammals. Parthenogenesis may be produced by mechanical or chemical means.

Chemical means:

Artificial parthenogenesis is induced by treating the eggs with the following chemical agents:

1. Hypotonic or hypertonic sea-water.
2. Chloroform.
3. Blood serum.
4. Fatty acids like lactic acid, butyric acid etc.
5. Fat-solvents like alcohol, ether, acetone etc.
6. Urea.
7. Chlorides of K, Ca, Na, Mg etc.

Mechanical means:

Artificial parthenogenesis is induced by the following mechanical methods:

1. High or low temperture
2. Ultraviolet light.