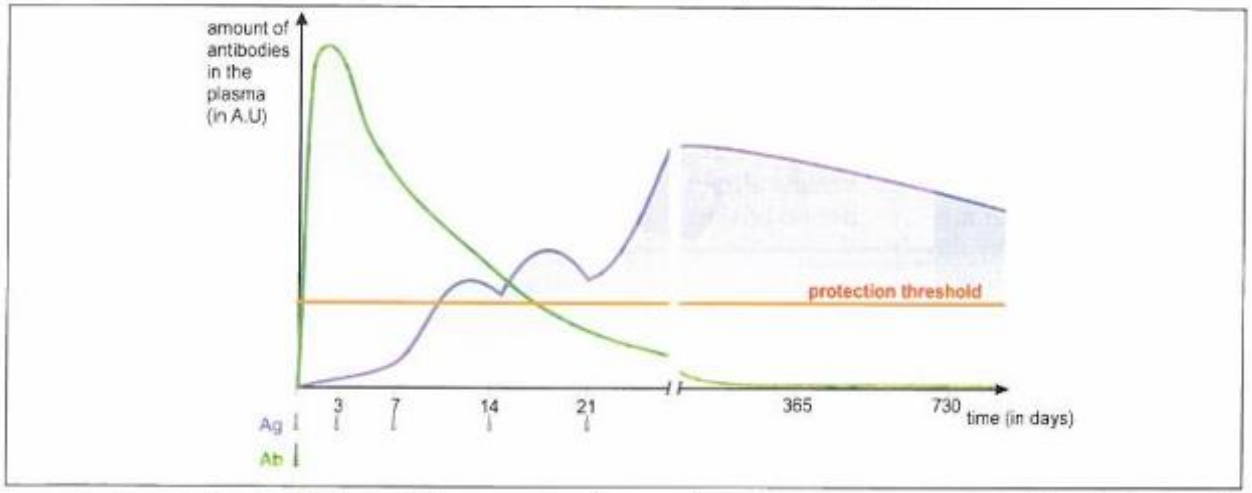
Selected Exercises of the National Book

- ***Exercise II,III and IV***

Exercise II

A young child is bitten by a dog that is suspected to be infected with rabies virus. Rabies may be transmitted through the bite. The clinical signs of the infections do not appear for several weeks, but this disease is always fatal.

To avoid any risk, his doctor procedes to a sero-vaccination: he gives him two different intramuscular injections, one of specific anti-rabies virus antibodies (serotherapy), the other of chemically inactivated rabies virus (vaccination).The child receives subsequently four other vaccine injections, on day 3, 7, 14 and 21 following the bite. The graph below shows the evolution in the concentration of injected antibodies and antibodies produced by the child, with time. The protection threshold represents the minimum antibody concentration required for protection from the disease.



a- Interpret the evolution of the curves of injected antibodies.

b- What is the duration of protection ensured by the serotherapy? What is that of vaccination?

c- Interpret the curve of produced antibody with respect to repeated vaccine injections, and deduce the importance of all these injections.

d- Make a comparative table of the mode of action of serotherapy and vaccination, based on the following criteria: nature of the injected substance, origin of the antibodies, latency time and duration of protection.

e- Why is serotherapy called passive immunization and vaccination called active immunization?

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Exercise II solution

a- The curve of injected antibodies shows that their concentration increases in the individual's serum within a few hours following their injection. Later, it drops progressively until it falls below the protection threshold after 17 days. This shows that the injected antibodies provoke an immediate Immunity in a very short time.

b- Serotherapy provides protection for 17 days, while vaccination is protective for many years (after the fifth injection).

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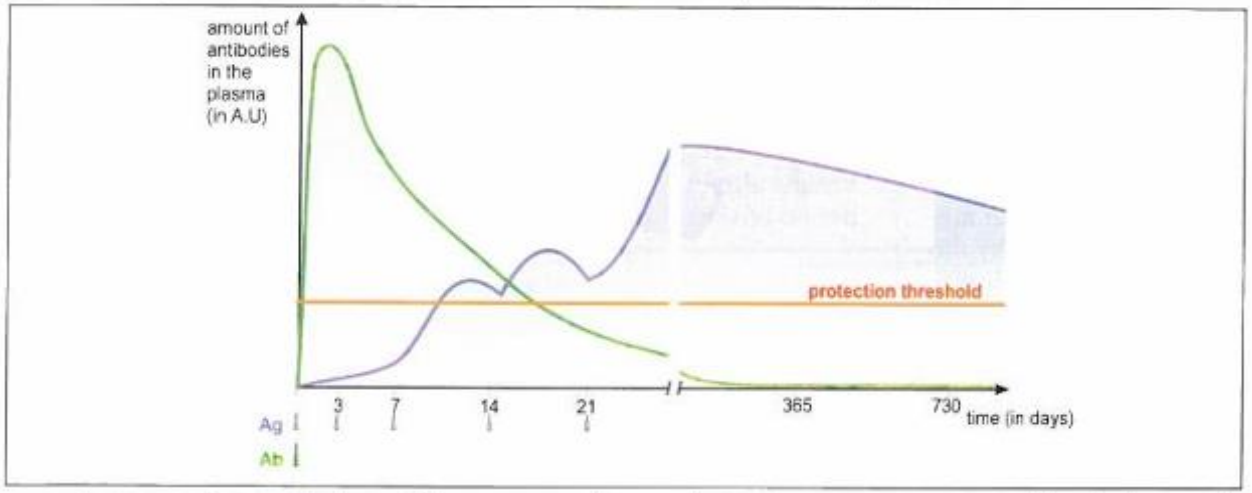

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c- At time 0 days following the first injection of vaccine, the amount of antibodies in the child's plasma was null. Following the vaccine injection on the 3^{rd} day, the amount of antibodies is almost null. It increases after the third injection (on the 7^{th} day), then it slightly decreases. Then after the fourth injection (on the 14^{th} day) the amount of antibodies increases slightly then decreases. Following the fifth injection(on the 21^{st} day) the antibodies increase and remain above the, threshold for many year.

This means that vaccination provides not immediate immunity that is more persistent.

Repeated injections are therefore necessary to ensure an efficient and durable (long lasting) protection.

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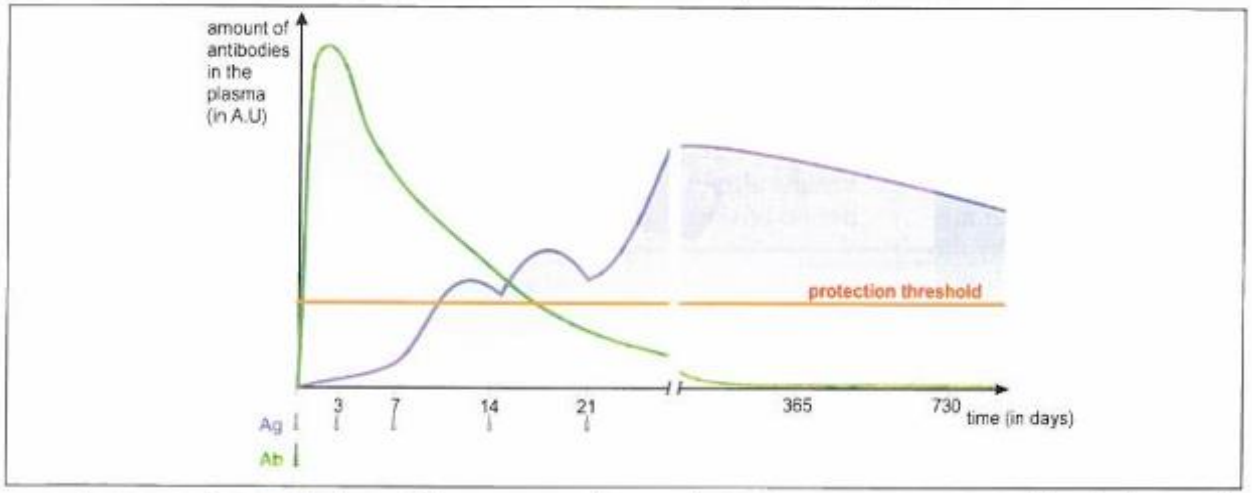

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d- **Comparative table of the mode of action of serotherapy and vaccination.**

	Serotherapy	***Vaccination***
Nature of the injection	Antibody(anti rabies virus antibodies)	Antigen(inactivated rabies virus)
Origin of the antibodies	Exogenous (from another individual)	Endogenous (made by the vaccinated individual)
Latency	(Fast)few hours	10 days (long)
Protection duration	2 weeks	Several years

e- Serotherapy is cold passive immunization because is provides the individual with " ready made" antibodies and does not activate his / her own immune system; on the other hand, vaccination is an active immunization because it activates the immune response of the individual, who then manufacture his / her own antibodies.

☐ *Exercise III*

Six isotonic media are prepared in haemolysis tubes where sheep red blood cells (SRBC) are added in the presence of antibodies and other substances. The tubes are stored in an incubator at 37° and observed 1 or 2 hours later.

The media's composition and results are indicated in the next table.

- Interpret the obtained results and draw out the mode of action of both antibodies and complements present in these experiments.

Tube n°	Content	Results
1	1.5 ml Nacl 9‰	Sedimentation of the intact SRBC
2	1.5 ml anti-SRBC rabbit antibodies	Sedimentation of the agglutinated SRBC
3	1 ml anti-SRBC rabbit antibodies + 0.5 ml complement of a rabbit	Hemolysis, destroyed SRBC
4	1 ml anti-SRBC rabbit antibodies + 0.5 ml complement of guinea pig	Hemolysis, destroyed SRBC
5	1 ml NaCl 9‰ + 0.5 ml of guinea pig complement	Sedimentation of the intact SRBC
6	1 ml antibodies of guinea pig RBC + 0.5 ml complement of guinea pig	Sedimentation of the intact SRBC

Exercise III solution

- ***Isotonic solution: solution that has the same salt concentration as cells and blood. Cells are placed in isotonic solution to prevent their bursting or shrinking.***

1- Interpret the results in tubes 1.2 and 6. what do you conclude?

Isotonic media where prepared in different tubes having SRBC stored at 37°C for 1 – 2 hours. In tube 1or tube 6 placed under the same conditions except in the presence of 1ml antibodies of pig RBC and 0.5 ml complement of a pig, there was sedimentation of the intact (complete) SRBC. While after placing 1.5ml anti SRBC rabbit antibodies in tube 2, sedimentation of the agglutinated SRBC was observed. This means that, only specific antibodies agglutinate to SRBC antigens.

Therefore, specific antibody ensure the agglutination of the corresponding antigen.

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5	1 ml NaCl 9‰ + 0.5 ml of guinea pig complement	Sedimentation of the intact SRBC
6	1 ml antibodies of guinea pig RBC + 0.5 ml complement of guinea pig	Sedimentation of the intact SRBC

2- Compare the results in tube 3.5 and 6. What do you conclude?

In tube 3, where anti-SRBC and complement of a rabbit were added, there was destruction of SRBC by hemolysis. However, in tubes 5 and 6, where there are no antibodies or specific antibodies of the SRBC, there was sedimentation of the intact SRBC (no destruction of SRBC by complement).

Therefore, the complement destroy SRBC agglutinated by specific anti-SRBC antibodies.

3- Draw out a conclusion referring to the results in tube 4.

THUS, the complement of any species ensures the destruction of the antigen(SRBC) which is bound to its specific antibodies.

Tube n°	Content	Results
1	1.5 ml Nacl 9‰	Sedimentation of the intact SRBC
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5	1 ml NaCl 9‰ + 0.5 ml of guinea pig complement	Sedimentation of the intact SRBC
6	1 ml antibodies of guinea pig RBC + 0.5 ml complement of guinea pig	Sedimentation of the intact SRBC

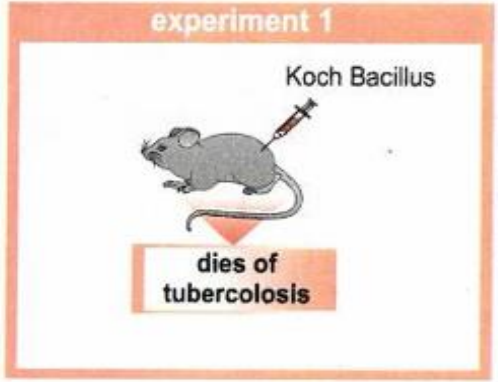
Exercise VI

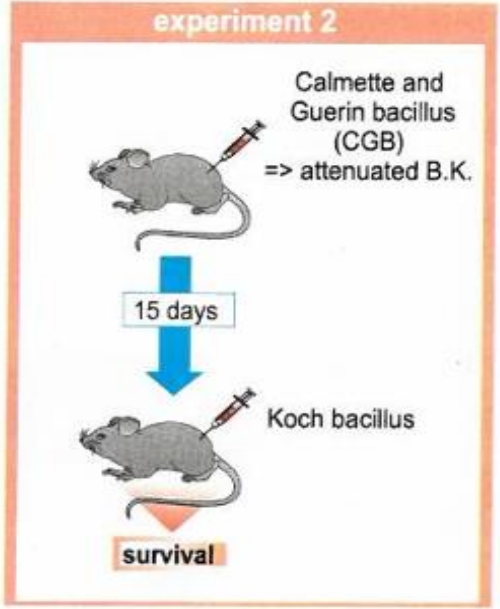
Koch bacillus (KB) is the agent of tuberculosis, a serious disease that is declining due to antibiotics. This aerobic bacillus resides mainly in the lung tissue and causes serious lesions, which are often fatal if not treated.

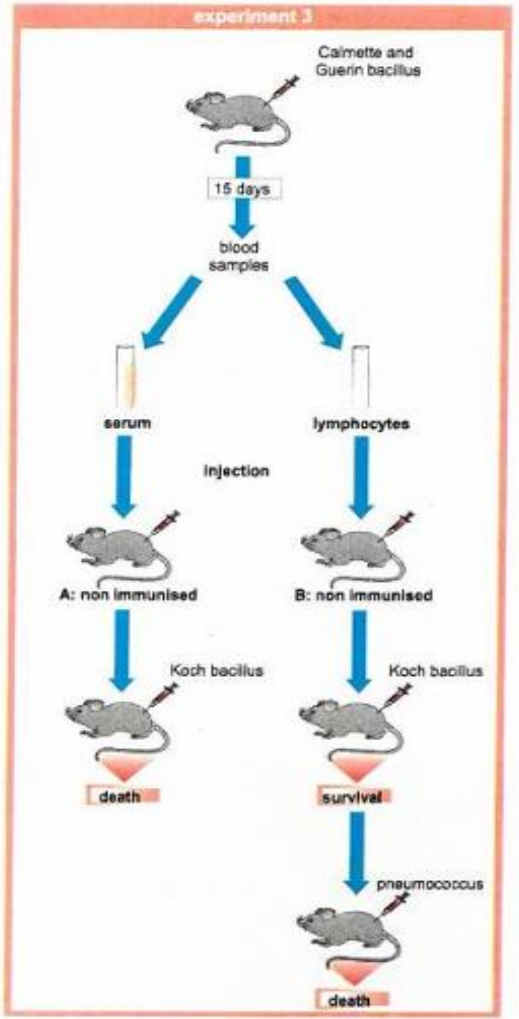
Three experiments were performed on guinea pigs; they are illustrated in the next figure.

a-Describe, in a few lines, each of these experiments.

b-Analyze every experiment and draw out the adequate conclusions.



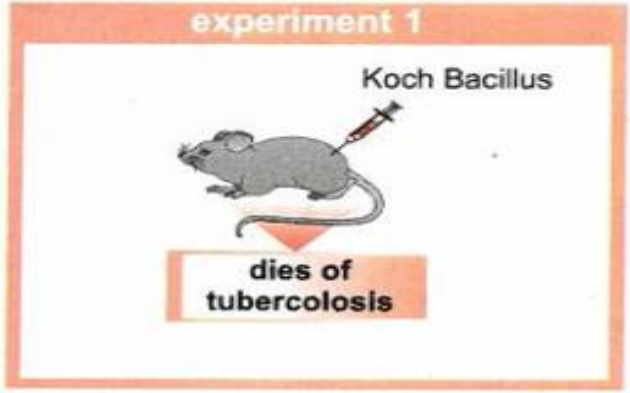


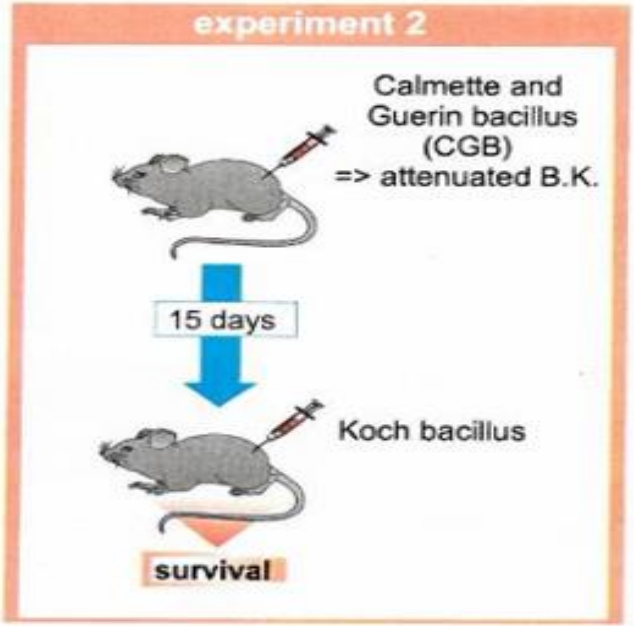


Exercise VI solution

a- **Experiment 1:** A guinea pig received an injection of KB; it contracted tuberculosis and died.

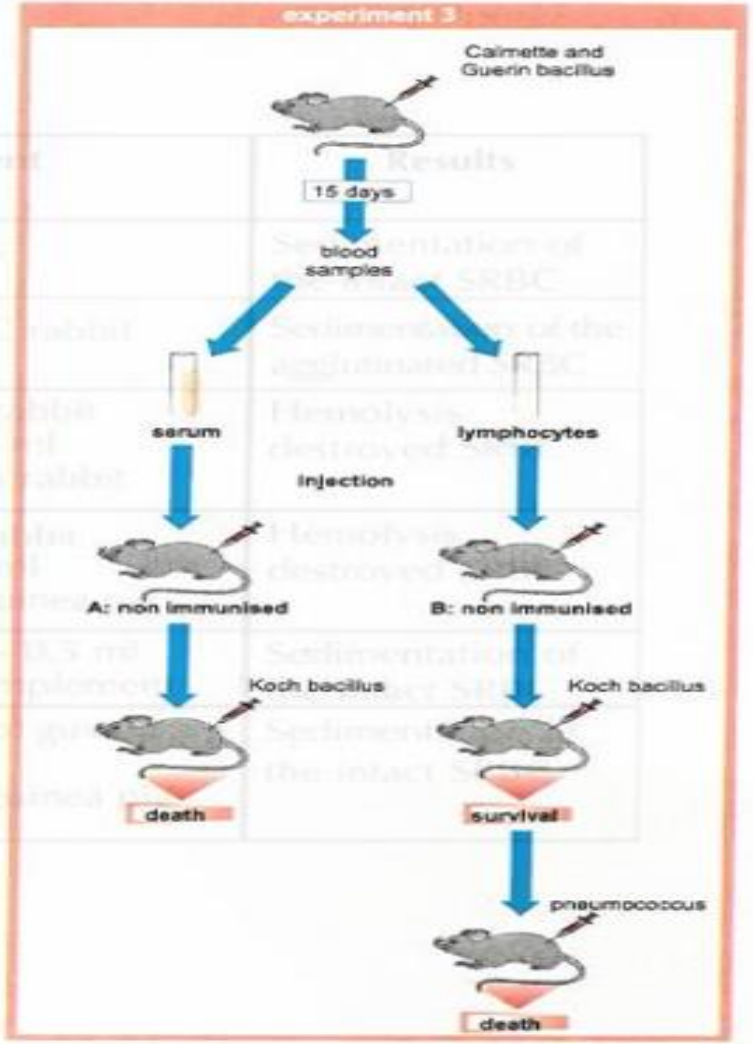
Experiment 2: A guinea pig received an injection of CGB (CALMETTE and GUERIN bacillus). Fifteen days later, it received an injection of KB and survived.





a- **Experiment 3**: A guinea pig received an injection of CGB. Fifteen days later, some blood was taken from it and then divided into two portions, serum and lymphocytes. The two portions were later injected separately into two immunized pigs, AB. Then an injection of KB was given to each.

Guinea pig A that has received the serum died, whereas guinea pig B that has received the lymphocytes survived. After that it was injected with pneumococcus, it died.



- **Analyze experiment 1. What do you conclude?**

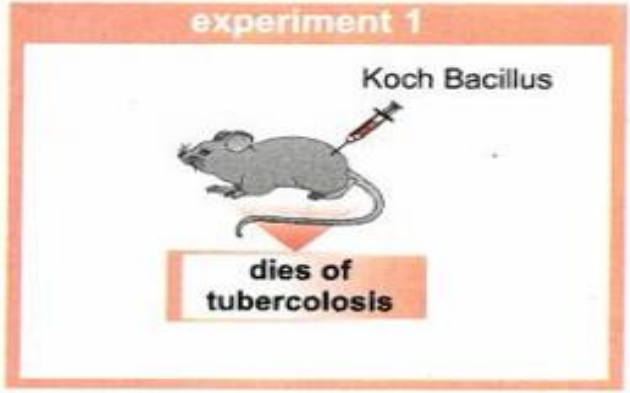
  Upon injection of Koch Bacillus into guinea pig, it died.

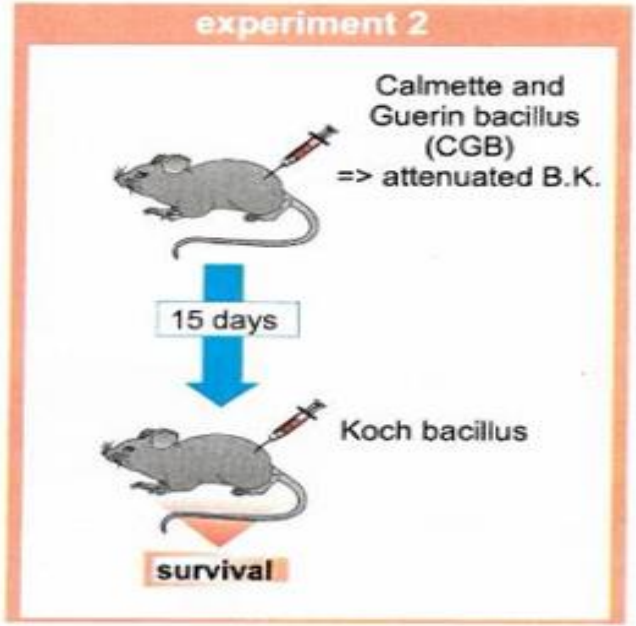
  Therefore, Koch Bacillus is fatal.

- **Interpret experiment 2.**

  Upon the injection of attenuated K.B (CGB) into a guinea pig followed by the injection of K.B, it survived.

  This means that, the guinea pig had been immunized against KB after the previous contact with CGB .





- **Interpret experiment 3.**

Analyze…

This means that specific lymphocytes are involved in the defense of the animal against KB and not serum.

- **Explain the death of the pig after it received a pneumococcus injection.**

….., because the pig B was not immunized against pneumococci, so there are no memory cells to ensure its protection against the virulent pneumococcus.