of the fibres (see Figure 2A); (b) only one cluster of diformazan which occupies the central zone of the fibre (see Figure 2B); (c) a big and compact cluster, where no grains are individualized, occupying the fibre entirely (see Figure 2C).

These three kinds of reactions are explained as different zones, disposed all along the fibre and coinciding with the ones described morphologically[2]: (a) A zone with well-differentiated motor innervation and myofibrils, whose reaction for the succinic-dehydrogenase is similar to the completely developed extrafusal fibres. (b) A zone with nuclei disposed in the central zone of the fibres, whose reaction for the succinic-dehydrogenase is perinuclear, and having predominance at the poles similar to the embryonary myotubes[1,3]. (c) A zone in which the nuclei are disposed in several rows with intense internuclear reaction for the succinic-dehydrogenase, and that resembling zone b is a zone where there are sensitive neural ends. The distribution of the enzyme is similar to the description that we have given of it for the muscle bud ends in vitro[3].

Briefly, we think it of interest to narrate these discoveries because they relate, as we believe for the first time, the distribution of the succinic-dehydrogenase with the three morphological zones in the intrafusal fibres which have been described for a long time. Yet we do not dismiss the possibility that some of our observations correspond to the presence of red and white fibres in the neuromuscular spindles as suggested by neurophysiological work[2]. However, at this point of our studies, we think it too soon to advance this hypothesis for certain.

Zusammenfassung. Mit der Succinodehydrogenasetechnik werden 3 verschiedene Zonen in den Muskelfasern der Neuromuskelspindeln des Hühnchens beschrieben.

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Facultad de Medicina, Departamento de Histologia y Embriologia, Montevideo (Uruguay), June 8, 1964.

2 S. COOPER, in *Structure and Function of Muscle* (Ed. G. H. BOURNE, 1960), vol. 1, p. 381.
3 N. I. GERMINO, J. P. WAHRMANN, and H. D'ALBORA, in press.

Ageing and Antibody Production in the Rat

Little precise experimental data deals with the immunological activity of aged organisms[1]. This study, however, concerns many problems both in the biological and in the clinical fields: antibody synthesis, homeostasis of the reticulo-endothelial system, resistance to infection, ageing mechanisms.

This communication deals with the comparative study of antiprotein antibody production in two groups of WAG (Wistar) rats, one aged three months (called 'young'), the other twenty-two months (called 'aged').

All animals were submitted to the same experimental conditions: identical balanced diet, same immunization techniques and identical dates of blood samplings.

Each group consisted of ten animals (seven females and three males) immunized against bovine serum albumin (BSA) (Behringwerke) mixed with incomplete Freund adjuvant (IFA) (Difco), of ten animals (seven females and three males) immunized against BSA mixed with complete Freund adjuvant (CFA) (Difco), and of two non-immunized animals used as controls.

For each group, the immunization procedure consisted successively in: (1) A first injection of 10 mg of BSA dissolved in 0.3 ml of physiological saline solution and emulsified in an equal volume of IFA or CFA. (2) A second injection of BSA emulsified as above, followed by a series of six injections of BSA without adjuvant. (3) A last injection of BSA emulsified in CFA. Each hind paw received half the dose by intramuscular injection.

The first blood sample (T_1) was taken four weeks after the first injection. The second sample (T_2) one week after the sixth injection of BSA without adjuvant, and the third and fourth samples (T_3 and T_4) respectively four and seven weeks after the last injection of BSA-CFA. The entire immunological study covered a period of over five months. The titer of anti-BSA serum antibodies was determined by the passive haemagglutination test as described by BOYDEN[2] and modified by STAVITSKY[3].

The results are presented in Figures 1 and 2, which clearly show a difference in antibody production in young and aged rats. The following facts can be pointed out:

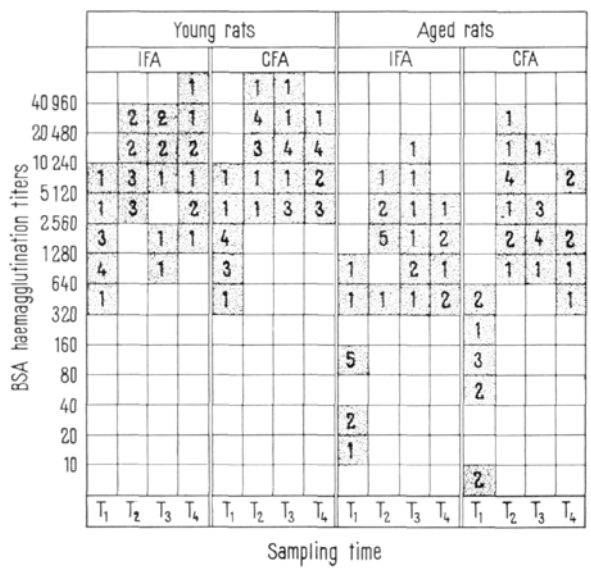

Fig. 1. In the black squares: number of animals showing identical BSA haemagglutination titers. IFA: rats immunized against bovine serum albumen mixed with incomplete Freund adjuvant. CFA: rats immunized against bovine serum albumen mixed with complete Freund adjuvant.

1 K. STERN, Gérontologia *7*, 118 (1963).
2 S. V. BOYDEN, J. exp. Med. *93*, 107 (1951).
3 A. B. STAVITSKY, J. Immunol. *72*, 360 (1954).

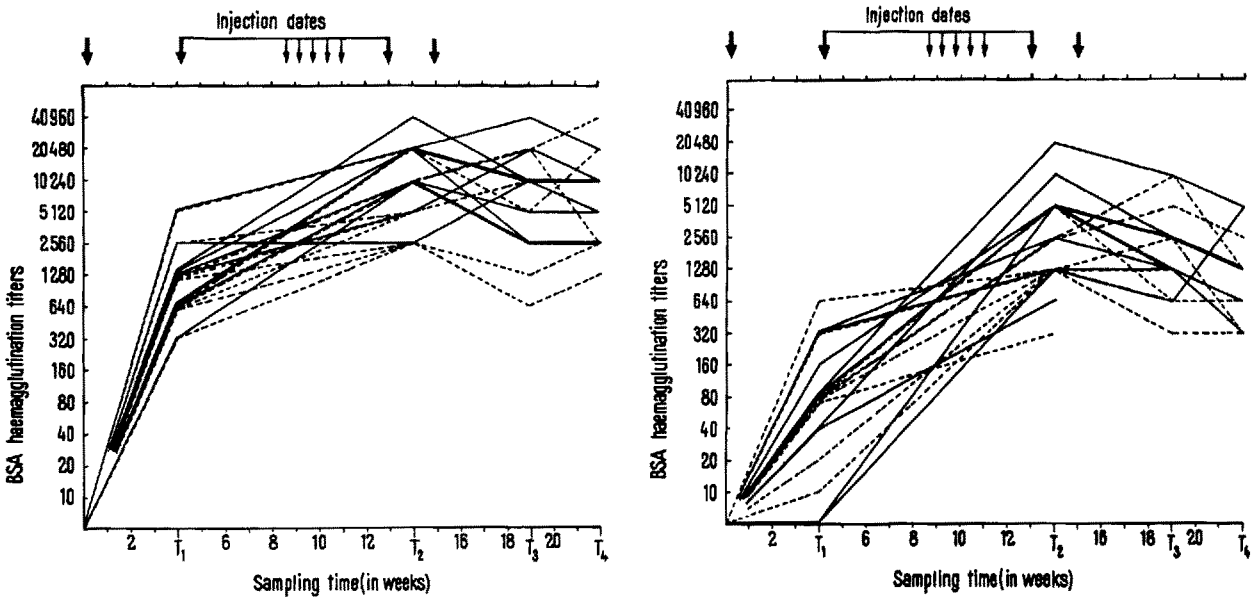

Fig. 2. Diagrams drawn by joining the points corresponding to the BSA haemagglutination titers in each animal. ·····, IFA; ——, CFA. Large arrow: injection of BSA mixed with adjuvant. Thin arrow: injection of BSA without adjuvant. Left: young rats; right: aged rats.

(1) Four weeks after the first injection of BSA mixed with adjuvant (T_1), the production of antibodies in aged animals is definitely lower and the individual values more scattered than in young animals. All the young animals produced antibodies that can be shown by passive haemagglutination; two aged animals have not produced measurable quantities. In both young and aged animals, the antibody production is practically unchanged whether CFA or IFA is used.

(2) After immunization has been continued (T_3), the production of antibodies by aged animals remains lower than in young animals. However, the repetition of the antigenic stimulus noticeably lowers the difference between young and aged rats. In both young and aged animals, the production of antibodies is higher when the animals have been immunized in the presence of CFA.

(3) After the last injection of BSA-CFA (T_3 and T_4), a certain irregularity in antibody production can be found in some animals. But on the whole there appears, in young animals, to be a stabilization in antibody production and, in aged animals, a beginning of decrease of this production.

Under the experimental conditions we used, the production of antibodies in the aged animals group has always been inferior to the production in the young animals group[4].

Résumé. La production d'anticorps antiprotéiques a été étudiée comparativement chez des rats de 3 mois et de 22 mois, par la méthode d'hémagglutination passive. Les résultats montrent et précisent la différence de comportement immunologique entre animaux jeunes et animaux âgés.

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[4] We thank Mrs. C. GAILLARD and Miss O. JEANNEQUIN for their technical assistance.

STUDIORUM PROGRESSUS

Postoperative Hypoxia after Extracorporeal Circulation: A Possible Graft against Host Reaction (Preliminary Communication)

The problem of respiratory insufficiency after extracorporeal perfusion for open heart surgery, particularly in correcting the tetralogy of Fallot, is one which has caused general concern. There are several reasons for the postoperative onset of such respiratory complications and these include pain, respiratory obstruction, and tampon-

ade. Even when these more obvious causes have been excluded there remains still unexplained a postoperative hypoxic state which clinically resembles pneumonia.

In recent months we have turned our attention to this particular type of hypoxia. Initially no auscultatory or radiological signs are present to account for the respiratory impairment which is manifested by a progressive desaturation in spite of positive pressure respiration with pure oxygen. At this stage it is difficult to separate a cardiac cause from a purely respiratory one, but measure-