it may be assumed that either the radiocalcium was removed from a homogeneous pool or that its deposition and removal occurred in the same area. Induced excess excretion of Ca^{45} and of other metals was also found after the administration of Ca-Na-EDTA. These experiments will be reported in detail elsewhere (*19, 20*).

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Agglutinin Linkage and Antibody Globulins

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Linkage of anti-A and anti-B isoagglutinins in some O sera was demonstrated by Landsteiner and Witt (*1*). Similar linkage can be demonstrated in some cases between "nonspecific cold agglutinins" which occur normally in most sera and cold agglutinins acting specifically at higher temperatures. A typical example out of nine such sera is given below.

An A_2B serum containing the "extra" agglutinin alpha$_1$ (anti-A_1) was repeatedly absorbed in the cold with O cells. Considerable loss of the anti-A_1 resulted.

Titer before absorption:	256
Titer after absorption:	16

Thirty sera containing isoagglutinins were similarly absorbed in the cold with O cells. There was no loss of isoagglutinin titer in any of these sera.

Linkage may therefore exist between isoagglutinins and isoagglutinins, and between cold agglutinins and cold agglutinins, but not between isoagglutinins and cold agglutinins. *It appears that linkage can only take place between antibodies in the same globulin fraction.*

This would be supported by the biochemical findings of Cohn (*2*) who showed that isoagglutinins do not belong to the γ-globulin fraction, to which cold agglutinins are believed to belong (*3*). The absorption experiments of Crawford and Mollison (*4*) also indicate that isoagglutinins and cold agglutinins belong to different globulin fractions. By absorption of anti-globulin sera with sensitized red cells from cases of hemolytic anemia, or with cells that have been exposed to incomplete anti-Rh, or to normal cold antibodies, they were able to prepare sera which would no longer agglutinate the type of cells used for absorption but could agglutinate one or more of the other types.

The work of Crawford and Mollison also suggests that the auto-antibodies of hemolytic anemias differ from the normal cold auto-antibodies. This would be in keeping with the different mode of origin of the two types, which are thought to arise from auto-immunization and heterogenetic bacterial stimuli, respectively. It would be difficult to confirm this by agglutinin-linkage studies, because the various red cells used for absorption would act in a similar manner upon both these types of antibodies.

Wiener (*5*) has emphasized that there is a slender line of demarcation between isoagglutinins and cold agglutinins. This is undoubtedly so, but there does seem to be a difference in their behavior when absorbed in the cold with O cells.

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Motor Nerve Filament Block Produced by Botulinum Toxin[1]

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Burgen, Dickens, and Zatman (*1*) have shown that during the neuromuscular paralysis produced by botulinum toxin (type A) excitation of a motor nerve releases no acetylcholine (ACh) from its muscular terminals. This finding could be explained by assuming either that the toxin blocks motor nerve terminals just proximal to the site of ACh-release, or that it interferes with the process of release itself. Experiments were carried out to decide between the two alternatives, using the cat's gracilis muscle *in situ* (*2*) and the guinea pig's excised serratus muscle

[1] This work will be reported in full at a later date. The project was supported by a grant from the Defence Research Board of Canada.

(*3*), mounted in a bath of oxygenated Ringer-Locke solution.

Neuromuscular block was produced by intravenous injection of 10^8 mouse LD_{50}, or by addition of toxin to the muscle bath (10^3 to 5×10^4 mouse LD_{50}/ml bath fluid). Action potentials of either groups of muscle fibers or of single fibers were recorded from the surfaces of the muscles at an end plate region. The end plate region was located by applying decamethonium or curare and finding sites from which end plate potentials could be recorded. Toxin was administered after neuromuscular transmission had been restored.

Conduction in nerve trunks, or in muscle fibers that were stimulated directly, was not affected by the toxin. On the other hand, it could be shown that the constituent muscle fibers of a motor unit become inexcitable to stimulation through the nerve trunk one at a time, or in very small groups. It was found that the block produced by botulinum toxin in its early stages can be overcome by the second of two motor nerve volleys, separated by at least 0.8 msec. If botulinum toxin paralyzes by reducing the ACh-output at nerve endings, rather than by blocking conduction in motor terminals, then the second, successful volley should be preceded by an end plate potential in response to the first, unsuccessful volley. However, no end plate potentials could be recorded in response to the first volley when it failed to excite.

The above electrophysiological evidence suggested that action of the toxin is on the nerve filaments rather than on the mechanism of ACh-release. If that is true, stimulation of the nerve terminals resulting from the current that passes through the muscle during direct tetanization of the muscle should release the normal amount of ACh from a preparation that was paralyzed to nerve trunk stimulation by botulinum toxin. Measurements were therefore made of the ACh released by the guinea pig's excised diaphragm (*a*) during tetanization of the phrenic nerves, and (*b*) during direct stimulation of the muscle. Direct stimulation of the muscle released the same amount of ACh as indirect stimulation, of the same frequency and duration. Blocking doses of toxin prevented the release of ACh by nerve stimulation, but failed to alter the release by direct stimulation.

It is concluded that botulinum toxin (type A) produces neuromuscular paralysis by interfering with conduction in the terminal twigs of motor nerves, close to, or at, the points of final branching, but proximal to the site of ACh-release.

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Comments and Communications

Altman's Theory of Economic Cycles

IT is intriguing to find in a leading scientific journal a paper that treats the mysteries of economic cycles with such assurance and finality as to arrive at a "mathematically necessary result." The "mathematically necessary result" of George T. Altman's "Cycles in Economics and Nature," to be cited as "CiEaN" (SCIENCE, **115**, 51 [1952]), means that the only way for the United States to escape repeated disastrous depressions is to change to socialism. Is such a conclusion justified?

Altmans theory, as elucidated with the aid of his book *Invisible Barrier* to be cited as "IB (Los Angeles: DeVorss & Co. [1949]), apparently runs as follows: In a particular country at a particular time, because of limitations imposed by manpower, natural resources, and the level of technological development, there is only a certain maximum amount of capital (v in CiEaN; C_θ in IB) that can be utilized efficiently. Capitalists, driven by the profit motive, periodically increase total invested capital (y in CiEaN; C in IB) till it becomes greater than v. This investment of "too much capital" causes the profit rate to fall. When the profit rate falls, capitalists sharply reduce investment, causing economic collapse. This reduction in rate of investment eventually causes y to become less than v. Consequently, profits rise, capitalists increase rate of investment, and another boom is on its way. These effects depend upon real, physical limitations on the use of capital and are not dependent upon speculative or inflationary value changes. The only satisfactory escape from recurrent cycles of boom-and-bust is to replace the profit motive by government control.

So runs the theory. In addition, Altman discusses in CiEaN a certain type of ecological system. His presentation of a single mathematical model supposed to fit both economic and ecological cycles may make it appear that the economic theory is based upon fundamental laws of nature applying to all living systems. I believe the appearance is illusory and that the ecological phenomena have no more to do with economic cycles than Newton's third law of motion has to do with rates of animal reproduction (see CiEaN, par. 9). For any of the numerous extant cycle theories, a mathematical model can be found, and it would be surprising if even one of these models should be without a counterpart in nature.