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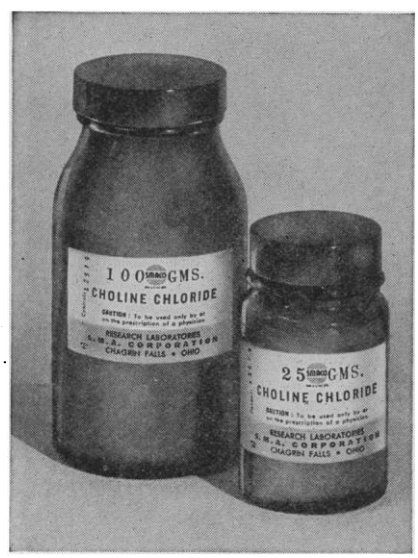

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THE NEW FRONTIERS IN THE ATOM[1]

By Professor ERNEST O. LAWRENCE

THE UNIVERSITY OF CALIFORNIA

THE anniversary celebration of a great university is indeed an important occasion, and it is appropriate to signalize the event by a symposium on "The University and the Future of America," for a great institution of learning is eternally youthful, and youth looks always to the future. I am greatly honored to be included in this distinguished gathering, and it gives me especial pleasure to join in wishing our sister institution many happy returns.

In a discussion bearing on the future, the scientist is always in something of a dilemma. On the one hand, he is cautioned to make only very limited prognostications, for he has learned the very limited region of applicability of existing knowledge and the likelihood of error in speculation. On the other hand, he faces the future with eager excitement and curiosity about what is beyond the present frontiers of knowledge, and he is naturally tempted to speculate and indeed to indulge in daydreams. Perhaps I may convey something of what is in the minds of physicists these days by a brief discussion of some recent developments of the current intensive attack on the new frontier in the atomic world—the nucleus of the atom.

[1] An address delivered at the fiftieth anniversary celebration of Stanford University, June 16. It will appear with illustrations in a volume to be published by the Stanford University Press.

ATOMS

The atomic constitution of matter has long been a keystone of natural science. At the beginning of this

TABLE I

COLLODION FIXATION IN ANTIPNEUMOCOCCUS SYSTEM

0.1 cc antiserum 0.3 cc saline 0.1 cc collodion suspension 0.5 cc capsular polysaccharide dilution	One hour at room temperature Centrifuged "Flipped" and read in terms of agglutinated particles

Antisera:	Horse antipneumococcus Type I		Rabbit antipneumococcus Type I
Pneumococcus capsular polysaccharide:	Type I	Type III	Type I
Antigen dilution			
10^{-5}	++++	–	+++
10^{-6}	+++	–	++
10^{-7}	+++		–
10^{-8}	++		–
10^{-9}	+		–
10^{-10}	+		–
Saline control	–		–

great delicacy of the reaction with antipneumococcus horse serum—in other experiments the limiting dilution of capsular polysaccharide was determined to be greater than 10^{-10}. (b) Antipneumococcus rabbit serum does not give this effect. In polysaccharide concentrations which produce a visible precipitate the visibility of the reaction is sharpened by the enmeshing of collodion particles, but there is no enhancement of limiting dilution. This result is precisely opposite that obtained with complement fixation, for with this reaction antipneumococcus rabbit serum gives positive results whereas horse serum fails. In so far as can now be determined the paradoxical results follow precisely a classification of species reported earlier.[5]

Although paradoxical in a species sense this reaction of collodion fixation bears many analogies to complement fixation. Thus, if the collodion particles are present at the time of antigen-antibody interaction an excellent result is obtained, whereas if they are added one hour after admixture of antigen and antibody the result is usually entirely negative.

That this method is applicable to work with filterable viruses is demonstrated by the results shown in Table II.

There is evidence to indicate that in virus systems the species derivation of the immune serum may be very important. Thus, in various experiments, human and goat immune sera have given positive results, whereas experiences with monkey and rabbit sera have thus far proven negative. It is probable that much will have to be learned of variables such as this before any general application to virus work can be carried out. Work already completed shows that the method can be applied successfully to the identification and typing of influenza virus in throat washings, to the identification of yellow fever virus, to the determination of the presence of antiviral antibodies in the sera of persons recovered from yellow fever, to the study of antibodies reactive with malarial parasites in both human and animal sera, to the reaction between poliomyelitis virus and specific antisera. The possibilities of application appear to be extraordinary in scope. This subject will be discussed at length at another place.

[5] F. L. Horsfall, Jr. and K. Goodner, *Jour. Immunol.*, 31: 135, 1936.

TABLE II

COLLODION FIXATION IN VIRUS-ANTIVIRUS SYSTEMS

0.1 cc antiserum 0.3 cc saline 0.1 cc collodion suspension 0.5 cc virus solution (1–100 dilution of original material)	Overnight in ice box Centrifuged "Flipped" and read in terms of agglutinated particles

Antiserum	Virus	Result
Normal goat serum	Fluid from chick embryos infected with "Influenza A" virus	–
Serum of goat immunized with "Influenza A" mouse lung preparation	" " " "	+++
" " " "	As above but infected with "Influenza B"	–
Normal human serum	Fluid from chick embryo infected with yellow fever virus	–
Human serum from convalescent yellow fever	" " " "	++

SUMMARY

Collodion fixation by immunological complexes presents a method of great delicacy—about 1,000 times that of any heretofore described reaction. This delicacy is of an order which may permit the *in vitro* identification of filterable viruses.

KENNETH GOODNER

LABORATORIES OF THE INTERNATIONAL HEALTH DIVISION,
THE ROCKEFELLER FOUNDATION

BOOKS RECEIVED

ALLEN, PAUL W., D. FRANK HOLTMAN and LOUISE A. MCBEE. *Microbes Which Help or Destroy Us.* Pp. 540. 102 figures. Mosby.

ANDERSON, H. V. and T. H. HAZLEHURST. *Qualitative Analysis.* Third edition, revised. Pp. xi + 266. Illustrated. Prentice-Hall. $3.70.

BABOR, JOSEPH A. and ALEXANDER LEHRMAN. *Laboratory Manual for Introductory College Chemistry.* Pp. 276. 56 figures. Crowell. $1.75.

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TULEEN, LAWRENCE F. and others. *Test It Yourself!.* Pp. vi + 290. Illustrated. Scott, Foresman. $0.96.

VON LAUE, M. *Physik und Chemie in Einzeldarstellungen. Band VI, Röntgenstrahl-Interferenzen.* Pp. viii + 367. 120 figures. Akademische Verlagsgesellschaft, Leipzig. RM. 32.