route of which covered 170 miles and included inspection of methods of control in the U. S. National Forests, with forestry officials acting as guides; visits to modern Indian Pueblos and sites of ancient pueblos where archeological work is being done. The route of the excursion led the party through a portion of the state which is of very great geologic as well as scenic interest.

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SPECIAL ARTICLES

BROMINATION OF OPTICALLY ACTIVE METHYLPHENYL- AND PROPYL-PHENYL-CARBINOLS

IT is the general conclusion of physical chemists that every reaction of substitution by a negative group or atom following a bimolecular course is connected with a Walden inversion. Granting that in the majority of reactions thus far observed this conclusion is valid, yet there is evidence that the conclusion is not *generally* valid. In the higher members of the homologous series of methylphenylcarbinols, from propylphenylcarbinol on, the reaction of bromination by means of hydrogen bromide gas proceeds, predominantly, without inversion. Certain considerations led us to investigate the effect of the temperature on bromination from 160° C. to −80° C. Dry hydrogen bromide gas was allowed to act on the carbinol. At 0° C. the reaction was practically instantaneous. The rotation of the bromide formed from *propylphenylcarbinol* (carbinol and bromide rotating in the same direction) increased markedly with lowering of the temperature of reaction.

At the higher temperatures of reaction, the rotation of the bromide formed from *methylphenylcarbinol* under similar conditions is opposite to that of the carbinol. The bromide showed a small increase in rotation with a drop in temperature, but *when the reaction proceeded at about −35° C. and at all lower temperatures, the rotation of the bromide obtained changed sign, the reaction then proceeding without inversion.*

The results are summarized in Table 1.

Thus it is evident that at every temperature two simultaneous reactions take place—one with, the other without inversion. At lower temperatures the latter predominates. That is, the reaction proceeds without inversion when the hydroxyl group has a higher mobility than the other three groups, for then the asymmetry of the molecule remains unchanged during the reaction of substitution. The reverse takes place at higher temperatures. The reason perhaps is that the mobility of the hydroxyl group has a lower temperature coefficient than that of the other groups.

TABLE 1

Methylphenylcarbinol $[M]^{25}_{5780.1} = -41.5°$

Propylphenylcarbinol $[M]^{25}_{5780.1} = -49.1°$

Compounds	Methylphenylbromomethane				Propylphenylbromomethane			
Temperature of Bromination	0 °C	−30 °C	−35 °C	−80 °C	160 °C	0 °C	−50 °C	−65 °C
$[M]^{25}_{5780.1}$	+13.5°	+36.4°	−22.6°	−27.0°	−1.3°	−41.7°	−146.5°	−154°

This observation may also have a practical significance, since by the changes in rotation with the lowering of temperature of the reaction, it may be possible to discern whether a reaction of substitution took place with or without inversion.

A complete report will be published elsewhere.

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IS AGGLUTINATION AN EXPLANATION FOR THE OCCURRENCE AND FOR THE CHROMOMERE-TO-CHROMOMERE SPECIFICITY OF SYNAPSIS?

NO current hypothesis accounts adequately for the occurrence of synapsis between homologous chromosomes. Still less do these hypotheses, electrical or otherwise, account for the one-to-one specificity displayed by hundreds of different pairs of chromomeres at synapsis.

The hypothesis here considered is that synapsis of homologous chromosomes is a process comparable to agglutination of a given kind of bacteria or blood corpuscles.

A necessary preliminary to the agglutination of a given bacterium is the formation of its specific antibody or antibodies. For example, when a rabbit is injected with bacteria, the surface materials of the

bacteria (antigens) stimulate the formation of antibodies by the animal and these accumulate in its blood. When such immune serum is mixed with a suspension of the exciting bacterium, the bacteria adsorb the corresponding antibodies upon their surfaces (antigen-antibody union) and become capable of adhering specifically to each other. Previous to the mixing of the antibody and the bacteria, the bacteria remained separate, apparently repelled by similar electrical charges. Removal of the mutual repulsion, by neutralization of the individual electrical charges, is apparently a general non-specific step in the agglutination mechanism. There seem to be no "attractive" forces involved, but contacts are brought about through random movements due to currents, to temperature agitation or to motility of the organism itself. When two bacteria coated with the same antibody chance to meet, a union is formed through the antibodies, and agglutination or clumping follows.

An animal may simultaneously produce antibodies against an indefinitely large number of kinds of bacteria. Also, immunization against one bacterium often results in the production of five or more demonstrably different antibodies and probably others which have not been demonstrated. All these antibodies act together simultaneously without interference in affording the animal protection against a simultaneous multiple infection.

Topley, Wilson and Duncan[1] showed that when a heterogeneous mixture of bacteria is agglutinated by a heterogeneous mixture of the specific antisera, each cluster of bacteria is homogeneous. The "forces" which determine the formation of clusters containing each a particular kind of bacterium are specific so that each cluster is a lattice of identical unions through the adsorbed antibodies.

The present hypothesis proposes that the specificity of chromomere synapsis is similarly effected by one or more specific agglutinins for each of the different chromomeres. The surface of each chromomere may be assumed to stimulate in the protoplasm the formation of specific antibodies just as do the surface antigens of each type of bacteria. It is not necessary that the contained genes themselves act as antigens (although they may do so), since the nucleoproteins of the envelope overlying each chromomere would be sufficient. The molecules of antibody which then chance to come in contact with the corresponding chromomere surface are adsorbed. Each chromomere thus becomes specifically capable of adhering to its partner chromomere and couples with it upon contact.

After the leptotene threads are produced in sperm- or egg-mother-cells, any two allelic chromomeres which touched would be cemented together by the antibody junctions specific for themselves. The chromomeres which are on each side of the already agglutinated ones would then be more likely to touch and fuse, so that synapsis would proceed, zipper-like, from the first points of homologous contact throughout the entire lengths of the chromosomes.

Since all the chromomeres of a given kind are coated with the same antibody, synapsis in auto-triploids or tetraploids could include all strands. Such inclusive synapsis for triploids and tetraploids is observed to be the case in the salivary gland pseudo-synapsis, and was formerly believed to be the general case. However, if meiotic synapsis occurs predominantly or exclusively in pairs (Darlington), then this would be similar to the formation of separate clumps in agglutination. In triploids, strands *a* and *b* would usually come into contact at different points than strands *b* and *c*, and pairing would proceed from the separate contact points.

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[1] W. W. C. Topley, J. Wilson and J. T. Duncan, *Brit. Jour. Exp. Path.*, 16: 116, 1935.

ROOT AND SHOOT PRODUCTION INDUCED IN CABBAGE BY BETA (3) INDOLE-ACETIC ACID

AT the suggestion of Professor George K. K. Link a study of the responses of cabbage to applications of Beta (3) indole-acetic acid was undertaken. Paste containing 30 mg of the acid per gram of lanolin was applied to decapitated first internodes of young seedlings. This treatment resulted not only in the production of an apical ring of adventitious roots, as reported for other plants, among them bean and tomato, but also in the production of viable shoots.

The first cellular response of cabbage upon application of the paste was enlargement of the cells underlying the cut, shortly followed by rapid cell divisions in the rays, phloem, parenchyma and endodermis. Root primordia were organized from the proliferated cells of rays and phloem, and their apical histogens were apparent by the end of 144 hours. Mounds of external callus tissue were produced on the cut surface, mostly over the phloem, and within them matured irregular areas of vascular tissue intermingled with highly meristematic regions in a very confused pattern.

Many of the decapitated and treated plants then developed shoots, which were detectable in 288 hours after treatment. They were found to arise either in the external callus or from internal callus (in the sense of Jost and Link) considerably below the cut surface at the level of adventive root production. Origin of shoots from internal callus was less fre-