the close of the telophase and closing with the first tendency towards the formation of the spireme or, in other words, to the so-called resting condition.

E. Haeckel described such a process of growth as the *perigenesis of the plastidules* though perigenesis as described by Haeckel is not referred to by Muller.

The sporophyte cell, from the end of the telophase to the beginning of the next prophase, would therefore become, normally, a tetraploid unit with the chromatic contents merely in need of distribution in the case of the vegetative division or, in the case of the reduction division, of random segregation. Actual return to the gametophytic condition is not accomplished till the second division since dyads are separated on the first or so-called heterotypic spindle.

It is assumed that the genes after the genesis of their like, reassemble in such a fashion that they form a continuous prophase spireme thread. It is during this reassembling of the genes, this reorganization of the nucleus, that the phenomena of crossing over may occur as well as perhaps some mutations not due to such factors as non-disjunction, re-duplication, deficiency, etc.

My material was examined in the living condition, by special staining methods of the living cells in sugar suspensions, by *intra-vitam* staining, and, as a check, by the standard fixing, hardening, and imbedding methods.

Detailed descriptions, drawings, and photographs will be published in the near future.

Harold C. Sands

Columbia University

---

## THE AMERICAN CHEMICAL SOCIETY

*(Continued)*

### DIVISION OF RUBBER CHEMISTRY

C. W. Bedford, *chairman*
Arnold H. Smith, *secretary*

Committee reports:

*Executive:* C. W. Bedford, *chairman.*
*Accelerator:* J. B. Tuttle, *chairman.*
*Physical testing:* C. O. North, *chairman.*
*Discusion of "Methods of Research Testing" by committee.*
*Analytical Standardization:* S. Collier, *chairman.*

*American conclusions regarding crude rubber:* (By title): O. de Vries.

*Chemical reactions of sulfur terpenes with rubber. I:* John B. Tuttle.

*Studies in vulcanization: mechanism of the acceleration of vulcanization of zinc ethyl xanthogenate:* H. A. Winkelmann and Harold Gray. The gaseous, liquid and solid decomposition products of zinc ethyl xanthogenate are shown to have no accelerating value. The activity of zinc ethyl xanthogenate as an accelerator is due to the unchanged molecule.

*Effect of certain tread pigments on temperature developed in pneumatic tires:* D. F. Craver. The paper is a short description of tread compounds used, stress-strain curves of same, theoretical conductivity as calculated by Williams formula, and the actual heating up of tire built with such treads when run on the road, temperatures being taken by means of thermo couple inserted by the awl which was devised by the research department of the New Jersey Zinc Company.

*Disubstituted guanidines:* Winfield Scott. Disubsubstituted guanidines function as accelerators as amines and belong to the class of hydrosulfide accelerators only. Diphenylguanidine reacts with hydrogen sulfide and carbon bisulfide to form a trithiocarbonate, with aniline and carbon bisulfide to form a dithiocarbamate and with carbodiphenylimide to form tetraphenylbiguanide. The effect of small amounts of zinc oxide and zinc carbonate on the tensile strength of rubber cured with disubstituted guanidines is quite marked. The relative curing powers of di-p-tolylguanidine, di-o-tolylguanidine and diphenylguanidine are in the order named, the first being the most efficient. It requires 25 per cent. more diphenylguanidine than di-o-tolylguanidine to produce the same acceleration.

*Studies in hysteresis of rubber compounds:* W. W. Vogt.

*Thermal changes during vulcanization:* Ira Williams and D. J. Beaver. The measurement of the temperature developed in the center of a cylinder of rubber sulfur mixture which is immersed in a constant temperature bath shows that heat is liberated during the first stages of the reaction. An absorption of heat is indicated during the later stages. The extent of these thermal changes has been estimated when stocks of different sulfur and accelerator content were cured at different temperatures. The relationship between the temperature developed and the per cent. combined sulfur is given.

*Zinc oxide in a new physical condition—its effect upon rubber compounds:* FRANK G. BREYER.

*Reactions of accelerators during vulcanization. V. Dithiocarbamates and thiuram disulfides:* G. W. BEDFORD and HAROLD GRAY. The metallic dithiocarbamates are true accelerators of vulcanization. Metallic oxides are necessary to prevent the decomposition of the metallic salts by hydrogen sulfide or to reform them after decomposition. Hydrogen sulfide changes thiuram disulfides to dithiocarbamates and decomposes the metallic salts. Ammonia increases the curing power of both thiurams and zinc dithiocarbamates. These views are supported by chemical data obtained in the laboratory in the absence of rubber.

*A method for the measurement of resistance to tear in vulcanized rubber:* ERLE C. ZIMMERMAN. A method is presented for measuring the resistance to tear of vulcanized rubber in terms of work. In this test a sheet of rubber 0.1 inch thick is supported between hooks on the ordinary tensile testing machine, and an autographic chart is taken as the rubber is torn. Resistance to tear is expressed as inch-pounds per square inch of rubber torn, in the formula,

$$W = \frac{KA - \frac{Fe}{2}}{Lt}$$

in which "$K$" is a constant, "$A$" is the work area on chart, "$L$" is the distance torn, "$t$" is the thickness, "$e$" and "$F$" are the elongation and force in equilibrium at the end of the test. Some data are given of resistance to tear in zinc oxide and pure gum stocks.

*The results of variation in the sulfur and hexamethylenetetramine content on some of the properties of compounded rubber:* H. A. DEPEW. A non-blooming compound must not contain more than 1 per cent. of free sulfur calculated on the rubber. Using hexamethylenetetramine as an accelerator, the tensile strength, elongation and maximal area under the stress-strain curve increase with a decrease in the amount of sulfur used, and to a lesser extent are increased by using a large amount of accelerator. The shape of the stress-strain curve is not affected by the sulfur and accelerator content. The vulcanization coefficient at the optimum cure depends on the sulfur content.

*An abrasion machine by which comparative wear tests can be made on laboratory test pieces or on sections cut from tire treads:* H. A. DEPEW. A simple abrasion machine is described, on which laboratory test pieces or sections cut from tire treads can be tested for comparative resistance to the abrading or rasping influence of surfaces of known composition. The test pieces fastened at one end, only, are held against a common, uniformly moving, abrading surface with a definite uniform pressure. The effect of pressure upon the test piece and the effects of speed and composition of the abrading surface are discussed. A comparison of this method of testing with the loose abrasive method is given. Comparisons by service tests (tires and heels) are also made.

*The influence of certain compounding ingredients in hard rubber:* W. E. GLANCY. Several articles have been published showing the action of compounding ingredients in soft rubber goods. Very little has been published thus far with regard to the principles of hard rubber compounding. Graphs are shown which indicate the mass action effect of sulfur, the curing properties of lime and magnesia and the loading qualities of M. R., tire reclaim and resin in hard rubber mixtures.

*A convenient nomograph for rubber chemists:* W. R. HICKLER and W. E. GLANCY. Rubber chemists have frequently use for tables which will be available for converting the cure of a rubber stock from a known temperature and time to a different temperature with corresponding time. A formula has been worked out from experimental values and a nomograph constructed whereby it is possible to quickly find the desired cure.

*Rubber softeners:* P. M. AULTMAN and C. O. NORTH. The action of rubber softeners on rubber itself has received very scant attention from rubber chemists. The writers in an effort to find out this action heated vulcanized rubber in each of a large number of softeners until total disintegration ensued. The comparative rate of disintegration was also observed by means of a test in which the swelling of the rubber in the softeners was measured. This method was checked roughly. Sulfur, accelerators and both together were added successively to the softeners to find out their effect on the action, with the results that in each case there was an increase in the rate of solvation. The state of cure was also found to have an effect on the results, as the rate of solvation was found to be inversely proportional to the cure. Mixtures of softeners were found to have, in many cases, the average properties of their components. From these and compounding results, the writers are of the opinion that a definite relation can be worked out between solvating action and the effects of softeners on the stress-strain curve.

*The measurement of temperature in rubber articles by means of thermocouples:* Ellwood B. Spear and J. F. Purdy. Measurements of the temperature in rubber articles by thermocouples are all too low where the depth of insertion is not great, 1-3 inches, and where there is at the same time a temperature differential along the buried portion of the thermocouple wires. The correction to be applied depends upon the depth of insertion, the size of the wires constituting the thermocouple, and the temperature differential. A new method is given for measuring the temperature in pneumatic and solid tires. Correction curves are given for use where ordinary thermocouples have been employed.

*The limitations of the obscuring power test for compounding materials:* Ellwood B. Spear and H. A. Endres. Experimental evidence is presented in this article that the obscuring power test for compounding materials is unreliable and often misleading in the region where the diameter of the particles is in the neighborhood of one fourth the wave length of light, *viz.*, 0.1 mu.

*The crystallization of sulfur in rubber and the phenomenon of "blooming." I:* Herbert A. Endres. A solution of sulfur in rubber exhibits the same phenomena of diffusion, crystallization and super-saturation as are shown by solutions of sulfur in other solvents. When rubber saturated with sulfur at calendering or vulcanizing temperatures is cooled, the solubility is exceeded and the excess sulfur separates as super-cooled globules, dendrites or stable rhombic crystals, depending upon the rate of cooling. Sulfur bloom is always composed of rhombic sulfur; the stable form at room temperature. It may be caused by crystallization at the surface of the rubber, either directly from solution or by transformation from super-cooled globules or dendrites.

*The microscopic examination of rubber compounds containing antimony pigments:* A. F. Hardman. To secure a section of a rubber compound sufficiently thin for microscopic examination, some method of hardening must be employed previous to sectioning. Sulfur monochloride has been successfully used for this purpose, but the reagent attacks and destroys the identity of the sulfides of antimony. A bath of molten sulfur may be used to produce the required rigidity without materially altering the appearance of the antimony pigments. Photomicrographs illustrating the new method are shown.

*The resilient energy and abrasion resistance of vulcanized rubber:* H. W. Greider. A study has been made of the effects of several compounding pigments upon the abrasion resistance of vulcanized rubber. It was found that gas black gives the greatest resistance to abrasion, followed by light magnesium carbonate, china clay, zinc oxide, colloidal barium sulfate and lithopone, in the order named. There is found to be a relationship, but not a direct proportionality, between tensile strength and abrasion resistance for rubber compounded with reinforcing pigments. Resilient energy gives an approximate index of abrasion resistance with gas black, magnesium carbonate, china clay and zinc oxide, but it is not a measure of abrasion resistance with colloidal barium sulfate or lithopone. The data appear to show that hardness (or rigidity) is also a factor in resistance to abrasive wear. The product of resilient energy and hardness is suggested as an index of toughness. Some principles are suggested which may be of value in compounding rubber to obtain high resistance to abrasion, including the use of high-grade accelerated mixings and combinations of reinforcing pigments in such proportions by volume as to give proper rigidity combined with high resilient energy. Combinations of gas black and magnesium carbonate in suitable proportions are found to give high resistance to abrasion, high resilient energy and considerable hardness and rigidity.

*Persistence of calender grain after vulcanization.* (Lantern): W. B. Wiegand and H. A. Braendle.

*A study of the relation of the structure of mercaptobenzothiazole and its derivatives to their value as accelerators of vulcanization.* (Lantern): L. B. Sebrell and C. E. Boord. The preparation of mercaptobenzothiazole derivatives by the methods reported in a previous paper has been extended to include several new mercaptothiazoles not previously described. Other compounds having a similar structure have been prepared and their curing power compared with that of mercaptobenzothiazole. In this way the particular grouping responsible for the activity of mercaptobenzothiazole as an accelerator has been identified. The effect of substitutents in the benzene nucleus of mercaptobenzothiazole upon its activity as an accelerator has also been studied.

Charles L. Parsons,
*Secretary*