Modification of Mitosis by Chemicals[1]

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The mitotic chromosomes of guayule (*Parthenium argentatum*) are difficult to study because they are small, numerous, and tangled. Treatment with colchicine, found advantageous with *Phlox* (*1*), failed to facilitate the study of guayule chromosomes. It was found however, that *p*-dichlorobenzene could be used in a technic which permits precise chromosome studies not only in guayule but also in other plants (*2*).

Preliminary work showed that 8 chemicals reported to induce polyploidy could shorten and straighten the chromosomes of *Crepis capillaris* (2n = 6). The most effective concentration of each chemical was determined, and the relative percentages of diploid (2X) metaphases, tetraploid (4X) metaphases, and anaphases were found after each chemical treatment (Table 1).

TABLE 1

PER CENT OF METAPHASES AND ANAPHASES IN ROOT TIPS OF *Crepis capillaris* (2n = 6) AFTER 2-HR CHEMICAL TREATMENTS

Chemical	Concentration of chemical*	Mitotic divisions†		
		Metaphases		Anaphases
		2x	4x	
Acenaphthene	1.00	83	4	13
Chloral hydrate	0.10%	76	13	11
Chloroform-water	0.10	70	4	26
Colchicine	0.20%	98	2	0
Mercuric chloride	0.00005	80	1.5	18.5
p-Dichlorobenzene	1.00	89	6	5
Sanguinarine nitrate	0.005	78	4	18
Sulfanilamide	1.00	96	4	0

* Proportion of a saturated solution in distilled water at room temperature, except concentrations given in %.

† Forty mitotic divisions in each of 10 root tips, or 400 mitotic divisions, classified for each chemical treatment.

The chloral hydrate treatment produced far more tetraploid metaphases than did the other chemical treatments; apparently this drug allowed sister chromatids to separate from each other in spite of the absence of a normal, anaphase-producing spindle. The chloral hydrate and chloroform-water treatments sometimes caused the sister chromatids of some, but not all, of the chromosomes to separate from each other. This gave chromosome numbers intermediate between the diploid and tetraploid numbers; these divisions were classed as tetraploid.

No anaphases were found after the colchicine and sulfanilamide treatments. Perhaps sulfanilamide could be used to induce polyploidy during the current shortage of colchicine. The chloroform-water treatment gave a high percentage of anaphases. There are no comparable data on the percentage of anaphases without treatment.

Some late prophase chromosomes showed distinct minor coils after the treatments with chloroform-water, colchicine, *p*-dichlorobenzene, and sulfanilamide. Sister telophase nuclei were sometimes connected by chromatin bridges after the chloral hydrate, colchicine, and mercuric chloride treatments. Some of these bridges were formed by lagging chromosomes, while others may have been due to chromosome breakage and recombination.

References

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[1] Studies leading to this paper were made while the writer was employed by the Special Guayule Research Project, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, USDA.

On the Nature of the Interaction Between Actomyosin and ATP

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There is at present considerable interest in the nature of the interaction between adenosine triphosphate (ATP) and actomyosin (Weber's myosin). This interest originates in experiments which Engelhardt, *et al.* (*5*) performed on actomyosin threads manufactured by squirting a thin stream of concentrated protein solution into water. These investigators found that ATP induces an increase in tensile strength of actomyosin threads made in this manner. Subsequently, Szent-Györgyi and his collaborators (*3*) have reported that threads of actomyosin which are floating freely in water "contract" upon treatment with ATP. Furthermore, Buchthal (*2*) has emphasized the possible importance of the ATP-actomyosin interaction in the living muscle cell. He maintains that ATP can produce a contraction in a single muscle fiber. This contraction is associated with an action potential and is accompanied by a reversible decrease in birefringence of the fiber. Indeed, Buchthal (*1*) has stated that the "breakdown of ATP is the reaction nearest in time to the physical process of contraction."

Unfortunately, agreement is not general on the nature of the effect of ATP on the actomyosin molecule. Thus, in a study of actomyosin dispersed in KCl solution, rather than in the form of threads, Needham and co-workers (*3*) observed that both ATP and high concentrations of KCl bring about a drop in viscosity and flow birefringence of the protein solution. They concluded that these changes are the result of a coiling up of the actomyosin molecules. Contrariwise, Szent-Györgyi considered quite similar data to indicate that both ATP and high KCl concentrations

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