considerably from one individual to another and, as noted above, individual urine collections contained apparently specific and novel ketosteroids in Fractions II and IV. We are now endeavoring to accumulate quantities of these substances sufficient for chemical characterization.

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CONTROL OF FLOWERING WITH PHYTOHORMONES[1]

ATTEMPTS to influence flowering in *Ananas comosus* (L.) Merr. have involved experiments with certain synthetic phytohormones, including α-naphthaleneacetic acid, naphthaleneacetamide, naphthalenethioacetamide and a commercial product known as *Fruitone*. It has now been established that flowering can be induced in advance of the normal period or delayed until much later by the use of appropriate concentrations of these chemicals.

Typical data are given in Tables 1 and 2. Low concentrations of α-naphthaleneacetic acid (the compound used most extensively) applied as foliage sprays induced formation of inflorescences in advance of the normal period, but high concentrations, particularly when applied in solution at the apex, delayed flowering far beyond that of the controls. The fact that natural flowering of a uniform fall planting of slips occurs at a fairly definite season made it possible to schedule applications of the substances at desired intervals prior to normal differentiation of the inflorescence.

Flowering in *Ananas* involves a transition from the differentiation of vegetative structures to the formation of an inflorescence at the apical meristem. Steps in the process follow in succession, as already described.[2] The diameter of the meristem first widens, then flower bud primordia instead of leaf primordia are produced, and the peduncle elongates. The meristem gradually narrows again during the production of floral primordia and finally resumes differentiation of leaf primordia which give rise to the crown or top terminating the main axis of the plant.

An interval of about 2 months elapses from the time that the meristem first widens until the young inflorescence becomes externally visible in the center of the plant. From this fact it appears that the early stages in differentiation of the inflorescence must have followed shortly after the first application of the lowest concentration of naphthaleneacetic acid (Table 1). Conversely, differentiation of floral parts was greatly retarded by the highest concentrations (Table 2), although new leaves were formed after the applications which resulted in the longest delay in flowering. When early flowering was induced by the low concentrations of these chemicals there was no external evidence of abnormal development of tissues. When flowering was delayed for a long period of time, however, considerable distortion and constriction was observed in the portion of the stem and in the leaves at the level of the apical meristem at the time of application of the phytohormones.

TABLE 1

EARLY FLOWERING INDUCED BY DILUTE SOLUTIONS OF α-NAPHTHALENEACETIC ACID SPRAYED ON LEAVES FOUR MONTHS PRIOR TO NORMAL DIFFERENTIATION OF INFLORESCENCE

Concentration of solution Per cent.	Weekly applications No.	Plants No.	Plants which had formed flower buds at stated periods after first application	
			2 months No.	3 months No.
Controls	–	20	0	0
.001	6	20	20	20
.006	1	20	18	20
.006	3	20	9	19

TABLE 2

DELAY OF FLOWERING BY MORE CONCENTRATED SOLUTIONS OF α-NAPHTHALENEACETIC ACID POURED IN CENTER OF PLANT ONE MONTH PRIOR TO NORMAL DIFFERENTIATION OF INFLORESCENCE

Concentration of solution Per cent.	Biweekly applications No.	Plants No.	Plants which had formed flower buds at stated periods after first applicaton		
			4 months No.	6 months No.	8 months No.
Controls ..	–	20	19	20	20
.01	3	20	0	16	19
.05	3	20	0	1	7
0.1	3	20	0	0	3
0.1	1	20	0	18	20

Since the differentiation of the inflorescence itself was initiated (Table 1) in our experiments, the results differ from earlier uses of the same or similar phytohormones in the production of parthenocarpic fruits,[3,4] the hastening of flowering by seed treatments which accelerated growth[5,6] or premature flowering of tobacco which was said to be due to

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[1] Published with the approval of the Acting Director as Technical Paper No. 139 of the Pineapple Research Institute of Hawaii, University of Hawaii.

[2] K. R. Kerns, J. L. Collins and H. Kim, *New Phytol.*, 35: 305–17, 1936.

[3] F. G. Gustafson, *Proc. Nat. Acad. Sci.*, 22: 628–36, 1936.

[4] F. E. Gardner and P. C. Marth, SCIENCE, 86: 246–7, 1937.

[5] K. V. Thimann and R. H. Lane, *Am. Jour. Bot.*, 25: 535–43, 1938.

[6] H. L. Stier and H. G. duBuy, *Proc. Am. Soc. Hort. Sci.*, 36: 723–31, 1939.

hastening of the terminal growth after the flower buds were formed.[7]

The initiation of flowering by these substances does not necessarily imply that they are "florigens"[8] since they have other effects on plant growth. Furthermore, acetylene and ethylene, compounds chemically quite unrelated to these phytohormones, also induce premature flowering in *Ananas*.[9,10]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SELF-STERILIZING SURFACES

It is known that extremely small quantities of ionized silver can have a remarkable germicidal effect;[1] it has also been found that one must distinguish between effects produced by small silver ion concentrations in water (volume effect) and those occurring when microorganisms are brought into wetting contact with surfaces upon which Ag is absorbed (surface effect). In the former case the destruction of the organisms is mostly a matter of hours and a variation of the Ag concentration up to 2 parts per million produces no remarkable change in the rate of sterilization. Furthermore, it is difficult, if not impossible, to attack spores of bacteria, molds and yeasts. This behavior is quite at variance with the very rapid destruction of cells which come into close contact with the extreme Ag concentrations existing on surfaces with absorptive capacity for Ag. Here the destruction of large numbers of organisms is reduced to minutes.

This phenomenon suggests a practical application in the form of self-sterilizing surfaces with lasting activity, if the incorporation of an adequate supply of atomic silver which replenishes the surface continuously after a wetting contact can be realized. As many organic colloids, in particular the proteins, bind and thus remove the silver from the surface after contact with it, a disactivation results unless a process of replacement can be provided for.[2]

The conditions for the permanency of the self-sterilizing qualities is thus the use of a material which (*a*) exposes at the surface only a small fraction of its total silver content, (*b*) holds this fraction in a form almost insoluble in water but available to proteins, (*c*) protects the unexposed supply against chemical attack, (*d*) permits replacement by diffusion.

Numerous organic liquids could fulfil these conditions, but most practical applications of such surfaces require rigidity. The only rigid substances with adequate properties are vitreous materials of anorganic (glasses) or organic (plastics) nature. The diffusion rate appears to be too small for the former (unless in colloidal form), and even of the plastics only certain types have so far been found to provide for sufficiently fast exchanges.

The compounding of silver with the resins can occur in various ways, either by the dissolution or the colloidal dispersion of silver compounds into the monomers or half-polymers of a resin or by their dissolution or dispersion in solvents of the plastic.

The additional incorporation of stabilizing as well as plasticizing substances is important, also intransparent neutral filling materials are required where a protection of the interior of the material against photochemical effects on the silver content is needed.

The resulting compounded substance represents then a varnish-like viscous fluid which can be applied by brush, spray or impregnation to various bases like plastics, glass, wood, paper, cloth, etc. It is hardened *in situ* either by polymerization or evaporation of the solvents. These surfaces are tasteless and odorless, resist mechanical wear and chemical attack by weak acids and alkali solutions as well as boiling water. They are, however, sensitive to certain organic solvents. The amount of silver removed from the surface by, *e.g.*, touch with the lips is of the order of micrograms, *i.e.*, negligible from the toxic angle. The total quantity of silver which the surface material must contain varies widely with the intended use of the surface and with its intended degree of permanency, it amounts to approximately one gram of silver for 1,000 cm^2 of exposed surface for the heaviest type of duty so far developed.

By the choice of the proper resin, its degree of polymerization, quantity and type of filling materials, etc., it is possible to vary the rate of Ag replacement, the absorptive capacity for water as well as the hygroscopic qualities of the surface. Hence surfaces which will be wet most of the time and come in frequent touch with large quantities of protein-like substances must have a high replacement rate

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[7] A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 7: 447–476, 1935.

[8] M. Kh. Cajlachjan, *Compt. Rend. Acad. Sci., U. S. S. R.* (N.S.), 4: 79–83, 1936.

[1] Other metals, like gold and copper, share this property with silver at least to some extent. The reason for the particular focus on silver is due to its lack of toxicity compared with copper and its economic advantage over gold. It appears certain that similar materials can be developed with the incorporation of, *e.g.*, copper.

[2] The use of metallic silver surfaces may appear obvious because of the infinite supply of atomic silver. It is, however, easily demonstrated that metallic silver, even if very clean, is soon disactivated due to the formation of germicidally inert compounds.

[9] A. G. Rodriguez, *Jour. Dept. Agric. Porto Rico*, 16: 5–18, 1932.

[10] K. R. Kerns, "U. S. Patent No. 2,047,874," 1936.