tice of 40 mgs where 1 gallon at 10 ppm is used for each bushel of fruit.

All the treatments proved effective in delaying the abscission of the fruit. With the McIntosh variety, the percentages of fruit remaining on the trees on October 12 (22 days after commercial harvest) were:

Carbowax-water spray	78 per cent.
Aerosol	75 per cent.
Alcohol-water spray	74 per cent.
Control	36 per cent.

On October 30 (41 days after commercial harvest), 12 per cent. of the fruit still remained on the trees, whereas on the untreated trees no fruit remained.

With the Macoun variety the results were similar. Fifty-six per cent. of the crop remained on the aerosol-treated trees on October 17 (22 days after commercial harvest) compared with 33 per cent. on untreated trees; and on October 31 (36 days after commercial harvest) 27 per cent. of the fruit remained on treated trees as compared with 4 per cent. on untreated trees. The most striking results were obtained with the Kendall variety—87 per cent. of the fruits remaining on the treated trees on October 30 (35 days after commercial harvest) as compared with 2 per cent. on untreated trees. In fact, many of the fruits which remained were cracked and split due to continued growth.

No attempt was made to be economical with material in the aerosol treatment; the cylinder was exhausted at each application. It may be that the amount was in excess of what was needed. Nevertheless, even at the relatively high concentration of 40 mgs of growth-regulating substance per bushel of fruit, as used in commercial orchard spraying, 1 pound of aerosol containing ¼ per cent. of growth-regulating substance is equivalent to 28¼ gallons of water spray containing 10 ppm of growth substance.

The efficiency and ease of application by the aerosol method suggests the possibility of applying other materials by the same method, such as insecticides and fungicides,[6] at least to small trees, and of developing special equipment for application to large trees. The effectiveness of repeated applications at 7-day intervals is of interest in this connection.

An aerosol of 2–4 dichlorophenoxyacetic acid was also effective in delaying the abscission of the fruit. Not only did the fruits adhere tenaciously for a long period but they were more highly and more completely colored—especially those fruits which were in close proximity to the point of aerosol application. There may be other materials as well, which may prove useful in aerosol form for the prevention of pre-harvest drop of fruit.

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EFFECT OF MERTHIOLATE (LILLY) ON CERTAIN SPECIFIC PRECIPITATION REACTIONS[1]

THE use of Merthiolate (Lilly) as a preservative for blood serum is a general practice.[2] Since Merthiolate (Lilly) is sodium ethylmercurithiosalicylate ($C_2H_5HgSC_6H_4COONa$), a substituted benzoic acid, and would be expected to combine with antibenzoic acid serum, we have tested this possibility. Quantitative determinations were made of the effect of this compound on the precipitation by two antigens of antiserum (anti-X serum) obtained from rabbits inoculated with beef serum coupled with diazotized *p*-aminobenzoic acid. The precipitating antigens used were 1,8-dihydroxy-2,7-di(*p*-(*p*-azophenylazo) benzoic acid)-3,6-disulfonic acid naphthalene (Chrom X'_2) and ovalbumin coupled with diazotized *p*-amino benzoic acid (X-ovalbumin). Determinations were also made of the effect of Merthiolate (Lilly) on the specific precipitation of antisera obtained from rabbits inoculated with sheep serum coupled with *p*-arsanilic acid (anti-R serum) or with sheep serum coupled with diazotized *p*-(*p*-aminophenylazo)phenylarsonic acid (anti-R′ serum). The following antigens were used: 1,8-dihydroxy-2,7-di(*p*-azophenylarsonic acid)-3,6-disulfonic acid naphthalene (antigen XXXI); 1,8-dihydroxy-2,7-di(*p*-(*p*-azophenylazo)phenylarsonic acid)-3,6-disulfonic acid naphthalene (antigen XXX); and ovalbumin coupled with diazotized *p*-(*p*-aminophenylazo)phenylarsonic acid (R′-ovalbumin).

Evidence of interaction of antibody and Merthiolate (Lilly) was observed in several of these systems.

EXPERIMENTAL METHODS

Materials: The antisera and antigens have been described previously.[3,4,5]

The Reaction of Antiserum with Antigen and Merthiolate (Lilly): The reaction mixtures were set up in triplicate, with use in each series of experiments of the amount of antigen giving the largest amount of precipitate in the absence of hapten; borate buffer was used as diluent.[6] The tubes were allowed to stand one hour at room temperature and overnight in the refrigerator, and the precipitates were then analyzed by our usual method.[7]

The final concentrations of Merthiolate (Lilly) in the precipitating mixtures covered the range usually

[1] Contribution from the Gates and Crellin Laboratories of Chemistry, California Institute of Technology, No. 962.

[2] W. C. Boyd, "Fundamentals of Immunology." Interscience Publishers, Inc., New York, 1943, p. 342.

[3] L. Pauling, D. Pressman, D. H. Campbell, C. Ikeda and M. Ikawa, *Jour. Am. Chem Soc.*, 64: 2994, 1942.

[4] D. Pressman, J. T. Maynard, A. L. Grossberg and L. Pauling, *ibid.*, 65: 728, 1943.

[5] D. Pressman, S. M. Swingle, A. L. Grossberg and L. Pauling, *ibid.*, 66: 1731, 1944.

[6] D. Pressman, D. H. Brown and L. Pauling, *Jour. Am. Chem. Soc.*, 64: 3015, 1942.

[7] D. Pressman, *Ind. Eng. Chem., Anal. Ed.*, 15: 357, 1943.

used for preservation, *i.e.*, 1/5,000 to 1/15,000. The results are in Table 1.

DISCUSSION

In Systems 4 and 5, Table 1, Merthiolate (Lilly) in the concentrations used had an essentially negligible effect on the amount of precipitate. However, in Systems 2, 6, and 7 Merthiolate (Lilly) caused appreciable inhibition of precipitation, while in Systems 1 and 3 there were appreciable increases in the amounts of precipitate. The decrease in System 6 and the increase in System 3 definitely demonstrate that Merthiolate (Lilly) interacts with the antibody, since the same antigen was used in both experiments.

The effect of the hapten on the precipitation of the homologous serum, *i.e.*, anti-X serum, was to increase precipitation when Chrom X'_2 was used as the antigen (System 1) and to decrease precipitation when X-ovalbumin was used (System 2). The phenomenon of increased precipitation of anti-X serum with Chrom X'_2 caused by benzoic acids with large groups in the ortho position has been demonstrated previously.[5]

Others of our experiments (unpublished) have shown that precipitation of anti-R serum may be increased by negatively charged haptens other than arsonic acids, as is evidenced here also (System 3). It is interesting that maximum inhibition was observed with anti-R′ serum. This may well be due to the same phenomenon that has been discussed previously,[4] *i.e.*, looseness of fit of this antibody with hapten and antigen.

TABLE 1

EFFECT OF MERTHIOLATE (LILLY) ON SPECIFIC PRECIPITATION

Antisermu and borate buffer. Volumes as indicated; antigen solution, 1 ml; Merthiolate (Lilly) solution, 1 ml; pH of supernates, 8.1.

	Antiserum used		Antigen used		Vol. Buffer used	Moles of Merthiolate (Lilly)[a] added X 10^9			
	Type	Vol. ml	Type	Wt. μg	ml	0	550	1650	4950
						Amount of precipitate, μg[b]			
1	Anti-X	0.75	Chrom-X'_2	55.5	0.25	(441)	(364)	(542)	(583)
2	Anti-X	.33	X-ovalbumin	172.	.67	1148	(1104)	[1022]	766
3	Anti-R	.25	XXX	22.2	.75	733	870	(926)	(900)
4	Anti-R	.125	R′-ovalbumin	87.	.875	414	412	410	382
5	Anti-R	.50	XXXI	25.0	.50	456	480	472	452
6	Anti-R′	.50	XXX	29.4	.50	229	169	(98)	62
7	Anti-R′	.25	R′-ovalbumin	131.	.75	173	(158)	(98)	78

[a] These amounts correspond to final Merthiolate (Lilly) concentrations of 0, 1/13,500, 1/4,500, 1/1,500, respectively.
[b] Values for precipitates with azoproteins include precipitated antigen protein. Values are averages of triplicate analyses with mean deviation of ± 3 per cent.; duplicate analyses in parentheses, single analyses in brackets.

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SUMMARY

Merthiolate (Lilly), a substituted benzoic acid, has been shown to interfere, in concentrations usually used for preservation, with the specific precipitation of antisera against beef serum or sheep serum coupled with diazotized *p*-aminobenzoic acid, *p*-arsanilic acid, or *p*-(*p*-aminophenylazo)phenylarsonic acid. In some systems increased precipitation was observed, while in others decreased precipitation was observed.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A STRAIN GAGE RECORDER FOR PHYSIOLOGICAL VOLUME, PRESSURE AND DEFORMATION MEASUREMENTS

To measure and record the variety of pressure and volume changes encountered in physiological research, electrical means are particularly suitable, since they permit a combination of high fidelity of response, a wide variety of sensitivities, flexibility of experimental arrangement and instantaneous visualization of the phenomena to be recorded. Practically all known methods of converting mechanical into electrical energy have been utilized to obtain electrical records of pressure or volume changes or of mechanical deformations. The present report describes a new type.

The resistance wire strain gage, which is becoming increasingly useful in many industrial applications, has been found by us to be particularly suitable for electrical recording of plethysmographic and manometric measurements in physiology. The strain gage is a fine wire which undergoes resistive changes during stretch. In our physiological applications, the strain gage is mounted in conjunction with a volume or pressure capsule provided with a rubber or metal membrane. The gage is made one arm of a Wheatstone bridge. A deformation of the membrane of the capsule is transmitted to the wire and causes a resistive change in the gage. This produces an imbalance