nabam in soil increases hatching of tobacco cyst nematode eggs as it did those of the rootknot nematode. It is also shown that the magnitude of the effect is a function of time because the 5- and 7-day exposures increased the hatch significantly. The data further indicate that the hatching factor or its effect is retained by the eggs and cysts after their removal from the soil, for the hatching took place in tap water after the cysts were removed from the treated soil and thoroughly washed in water.

In a preliminary attempt to determine which fraction of nabam acts as a hatching factor, lots of soil and roots infested with rootknot nematodes were treated with ethylene thiuram monosulfide and ethylene thiuram polysulfide, compounds known to be decomposition products of nabam (*3*). No acceleration of hatching resulted. The findings by van der Kerk *et al.* (*4*) that some dithiocarbamates have growth-promoting properties and Stoddard (*5*) that nabam, both in solution and in soil, has root-promoting properties suggested that growth-promoting substances might act as hatching factors. However, α-naphthaleneacetic acid and 3-indoleacetic acid did not increase hatching of rootknot nematode eggs.

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9 July 1958

An Infrared Study of the Hydrolysis of a Thiazolidine

Abstract. The hydrolysis in *aqueous* solution of L-4-carboxy-2,2-dimethylthiazolidine hydrochloride has been followed by infrared spectrophotometry. The absorption curve of the final reaction mixture had absorption characteristics which were also shown by a solution containing stoichiometric amounts of the expected reaction products.

The product obtained when L-cysteine hydrochloride is refluxed in acetone is L-4-carboxy-2,2-dimethylthiazolidine hydrochloride (CDMT) (*1*). Woodward and Schroeder (*2*) followed the hydrolysis of L-4-carboxy-2,2-dimethylthiazolidine polarimetrically and showed that the compound dissociates to form cysteine and acetone. We have examined the dissociation of CDMT in water, using infrared spectrophotometric techniques.

L-4-Carboxy-2,2-dimethylthiazolidine hydrochloride was prepared [MP, 166°C (lit., 163° to 165°C) (*1*)]. Eastman Spectro grade acetone and cysteine hydrochloride monohydrate from Mann Re-

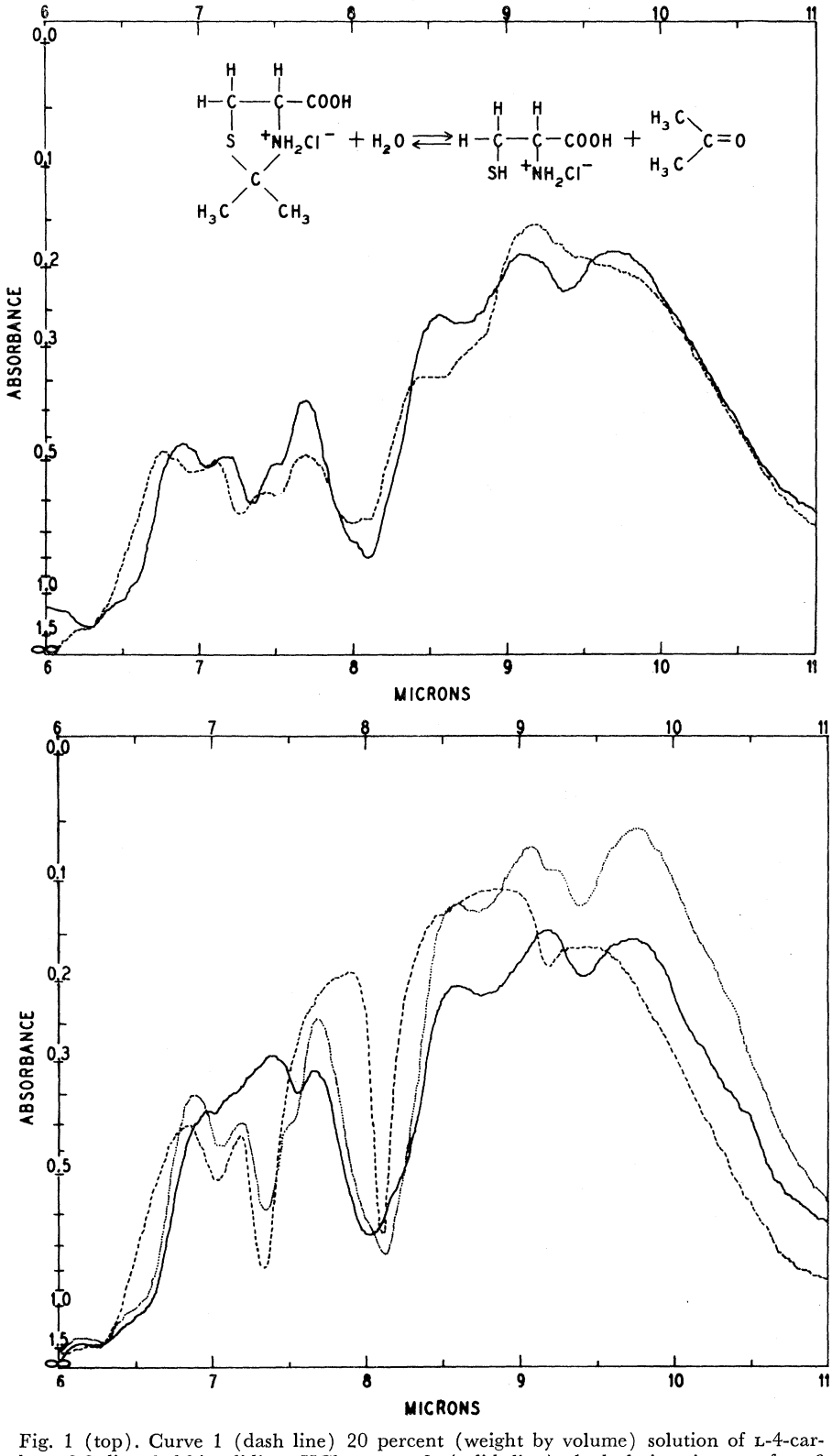

Fig. 1 (top). Curve 1 (dash line) 20 percent (weight by volume) solution of L-4-carboxy-2,2-dimethylthiazolidine · HCl; curve 2 (solid line), hydrolysis mixture after 6 hours. Fig. 2 (bottom). Curve 1 (solid line), 1.750 g of cysteine hydrochloride · H_2O in 10 ml of solution; curve 2 (dash line) 580 mg of acetone in 10 ml of solution; curve 3 (dotted line), cysteine hydrochloride · H_2O–acetone mixture containing the same amounts of solutes as for curves 1 and 2 per 10 milliliters of solution.

search Laboratories were used. Infrared spectra were obtained on a Perkin-Elmer model 21, double-beam instrument; a barium fluoride cell (0.052 mm) and a transmittance screen in the reference beam (*3*) were used. The spectrum of water has been published (*3*), and our spectrum for water corresponds to it.

A 20 percent (weight by volume) solution of CDMT was prepared and scanned as soon as possible after dilution to the mark, scanned again 5 minutes after dilution, and then scanned every 30 minutes thereafter for a total elapsed time of 6 hours. The scanning rate was approximately 30 sec/μ. Due to crowding of the curves during the run, only the initial and final curves are shown (Fig. 1), although the pen tracings during the experiment definitely showed progressive differences with time.

Examination of the spectra in Figs. 1 and 2 shows that CDMT has a slight resemblance to both cysteine hydrochloride and acetone. The spectrum of the solution of hydrolysis products (see Fig. 1, curve 2) closely resembles the spectrum obtained for a synthetic mixture prepared in the stoichiometric proportions expected for total hydrolysis (see Fig. 2, curve 3). The curve obtained (Fig. 1, curve 2) indicates that at the end of the 6-hour period the system is at equilibrium and that the point of equilibrium lies very close to total hydrolysis (*2*).

These data indicate that it is possible, by means of infrared spectrophotometric techniques, to follow the changes which small molecules undergo in aqueous solution if the concentrations of reactants and products are high enough and if their absorption spectra are sufficiently different. Similar experiments along these lines are being pursued.

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27 June 1958

Further Studies on the Relation between Metals and Natural Pigments

In 1955, we published in *Science* an article entitled "Nature of pigments derived from tyrosine and tryptophan in animals" in which the relation between sorts of metals and natural pigments was discussed (*1*). Shortly thereafter, Goss and Green (*2*) published analytical results on the copper content of hair from different species which did not agree with our results. Since we felt that the difference in results might be due to differences in the respective ashing procedures, we exerted much effort to establish the most adequate ashing method. At the end of 1956, however, we discovered that one of our previous associates had been untrustworthy. We have therefore been obliged to reexamine the experimental results of our cooperative work.

Table 1. Amounts of iron, copper, and nickel in animal hair and tissues, in parts per million (dry material). The numbers in parentheses indicate the number of measurements.

Species and tissue	Hair color	
	Black	White
	Iron	
Rabbit, hair	30.2 ± 4.3 (11)	38.1 ± 5.3 (11)
Mouse, hair	81.0 (1)	56.0 (1)
Pig, hair	173.0 ± 9.8 (4)	68.7 ± 2.1 (4)
Guinea pig, hair*	25.3 ± 0.9 (6)	25.6 ± 2.6 (6)
Guinea pig, hair†	30.7 ± 2.5 (2)	31.1 ± 2.0 (2)
	Copper	
Rabbit, hair	17.4 ± 2.1 (11)	18.6 ± 2.4 (11)
Rabbit, liver, adult	32.2 ± 3.6 (6)	26.6 ± 4.0 (6)
Rabbit, kidney, adult	38.2 ± 7.3 (5)	30.5 ± 5.3 (5)
Rabbit, skin, adult, without hair	10.0 ± 1.5 (3)	9.2 ± 1.1 (3)
Mouse, hair	17.7 ± 2.3 (6)	11.3 ± 1.1 (5)
Mouse, liver, adult	19.4 ± 4.3 (5)	17.1 ± 6.9 (5)
Mouse, skin, just after birth	21.6 ± 3.2 (6)	12.1 ± 0.7 (5)
Mouse, skin, with hair, 10 days after birth	16.3 ± 3.2 (2)	6.3 ± 0.5 (2)
Mouse, skin, adult, without hair	15.3 ± 2.2 (5)	6.8 ± 1.8 (5)
Pig, hair	17.1 ± 1.9 (4)	17.6 ± 0.9 (4)
Guinea pig, hair*	23.0 ± 2.0 (3)	23.7 ± 2.0 (3)
Guinea pig, hair†	19.7 ± 9.2 (3)	15.2 ± 4.7 (3)
	Nickel	
Rabbit, hair	0.18 ± 0.08 (2)	1.70 ± 0.41 (2)
Guinea pig, hair†	trace (1)	trace (1)

* Samples obtained from different animals.
† Samples obtained from the same animal with piebald hair.

Our main effort has been paid to the quantitative determination of Fe, Cu, and Ni involved in animal hair and tissue by wet ashing. Iron was determined by the *o*-phenanthroline method of Saywell and Cunningham (*3*), copper by the diethyldithiocarbamate method, and nickel by the dimethylglyoxime method (*4*). The revised results are summarized in Table 1.

Although in some cases our previous assumption that black hair contains more Fe and Cu and less Ni than white hair seems to be substantiated, this is not generally true. Presumably the metal content in animal hair and tissues varies according to the genetic background, as well as to the environmental condition, of the individual (*5*).

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Pain Sensitivity, Sensory Deprivation, and Susceptibility to Satiation

Abstract. The results reported bear out the hypotheses that (i) pain tolerance is positively related to satiability; (ii) sensory deprivation tolerance is negatively related to satiability. It is inferred that satiability may prove to be in part the mechanism of tolerance and intolerance, and that pain tolerance is inversely related to sensory deprivation tolerance.

Surgery of the brain's prefrontal areas can increase tolerance of pain without altering the perception threshold of pain. This operation of prefrontal lobotomy causes a constellation of changes in measurable aspects of personality (*1*). The fact that these changes are specifically present after lesions in this area of the brain and not in the four other areas studied, and that there are special types of personality that are most helped by surgery, suggests a relationship between personality and pain tolerance (*2*). The experiment discussed in this report examines this relationship further, with special emphasis on one variable in the constellation—perceptual satiation—and investigates the tolerance of pain and the tolerance of sensory deprivation as related to susceptibility to satiation.

In relation to an understanding of what underlies tolerance of pain and sensory deprivation, the measurement of satiation phenomena are of particular interest. Satiation was first described by Köhler, who showed that perceptual intensity diminishes after prolonged stimulation with a stronger stimulus (*3*). Thus, the fact that the size of an object which is touched with the hand appears to diminish after a period of stimulation by a larger object on the same hand is an example of satiation.

Michael Wertheimer (*4*) has demonstrated the existence of individual dif-