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Influence of Temperature on Stimulation of Oxidation *By Dinitro, Dihalo and Trihalophenols.*

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Nitro and dinitrophenols have been shown to stimulate the metabolic processes of many types of cells[1, 2] and to produce a reversible block to the cell division of fertilized eggs of a number of marine invertebrates. The analogous dihalo and trihalophenols exhibit similar properties when tested on marine eggs, but are unable to cause metabolic stimulation in intact mammals and other animals.[3]

Various tissues were subjected to treatment with 4,6-dinitro-o-cresol and a number of dihalo and trihalophenols at a series of environmental temperatures, oxygen consumption of the tissues being measured with Warburg microrespirometers.[4] The tissues included: fertilized eggs of *Arbacia punctulata* and *Nereis limbata;* a commercial baker's yeast (Anheuser-Busch), and various rat tissues.

From the data in Table I concerning the effect of various concentrations of 4,6-dinitro-o-cresol on Arbacia at 12°C., 20°C., and

TABLE I.

Stimulation of Oxygen Consumption of Fertilized Eggs of Arbacia and Nereis by 4,6-dinitro-o-cresol at Various Temperatures. Eggs and Reagent in Sea Water at pH 8.2.

Concentration 4,6-dinitro-o-cresol moles per liter	c.mm.O_2 per hour per 10 c.mm. of eggs					
	Arbacia			Nereis		
	12°	20°	27°	13°	20°	28°
0	1.67	3.22	5.55	0.63	1.47	2.22
10–6	2.18	3.92	6.95	0.84	2.08	2.81
2x10–6	2.74	6.37	9.10	1.11	2.28	3.07
4x10–6	4.36	9.66	11.80	1.31	2.68	3.13
8x10–6	6.10	9.42	11.05	1.91	4.02	4.12
1.6x10–5	5.90	8.42	10.35	2.82	5.80	5.95
3.2x10–5	5.20	7.20	9.40	3.74	7.75	—
6.4x10–5	4.17	5.33	7.70	4.09	7.20	9.90
1.28x10–4	3.06	3.89	6.10	3.89	6.55	9.95
2.56x10–4	2.83	3.08	4.70	3.02	5.25	7.80
5.12x10–4	2.36	2.33	3.68	2.97	5.15	7.05
1.02x10–3				2.19	3.87	5.90

1 Clowes, G. H. A., and Krahl, M. E., *Science,* 1934, **80**, 384.

2 Clowes, G. H. A., Keltch, A. K., and Krahl, M. E., *Biol. Bull.,* 1935, **69**, 341.

3 Krahl, M. E., and Clowes, G. H. A., PROC. SOC. EXP. BIOL. AND MED., 1935, **33**, 477.

4 Dixon, M., *Manometric Methods,* 1st Edition, Cambridge, 1934.

27°C., and on Nereis at 13°C., 20°C., and 28°C., it may be seen in each case that the optimum concentration for oxidative stimulation does not vary greatly with temperature. At the respective optimum concentrations, the number of units of excess oxygen taken up by the treated eggs increased as the temperature was raised. However, because of the greater rate of increase in oxygen consumption by the control eggs, the percentage stimulation decreased with increasing temperature.

TABLE II.

Stimulation of Oxygen Consumption of Yeast by Dinitrocresol, Dichlorophenol, and Trichlorophenol at Various Temperatures. The Suspension Medium Was 0.05M. KH_2PO_4, pH 4.45. Substrate—0.01M. Glucose.

	4,6-dinitro-o-cresol 10^{-5} M.		2,4-dichlorophenol 10^{-4} M.		2,4,5-trichlorophenol 10^{-5} M.	
Temperature ° C.	Qo_2 control	Optimum percentage stimulation	Qo_2 control	Optimum percentage stimulation	Qo_2 control	Optimum percentage stimulation
15.0°	32	43			32	45
20.0°	47	58	48	62	46	54
25.0°	83	28	84	19	86	25
30.0°	99	18	98	6	97	12

Similarly, it is shown in Table II, that the percentage stimulation of oxygen consumption in yeast is larger at 15°C., or 20°C., than at 25°C., or 30°C.

TABLE III.

Stimulation of Oxygen Consumption of Rat Kidney Slices by Dinitrocresol, Dichlorophenol, Trichlorophenol, and Triiodophenol. The Suspension Medium Was Ringer-phosphate, pH 7.35. Substrate—.02M Sodium Lactate.

Compound	Temperature ° C.	Qo_2 Control	Optimum molar concentration	Optimum percentage stimulation
4,6-dinitro-o-cresol	20.0°	7.3	10^{-5}	68
	37.0°	26.0	10^{-5}	43
2,4-dichlorophenol	20.0°	7.3	10^{-4}	41
	37.0°	24.6	10^{-4}	20
2,4,5-trichlorophenol	20.0°	7.4	10^{-5}	34
	37.0°	23.3	None	None
2,4,6-triiodophenol	20.0°	7.4	10^{-5}	14
	37.0°	18.4	None	None

The data of Table III show that each of 4 phenol derivatives gave a larger relative stimulation of lactate oxidation by rat kidney tissue slices at 20°C. than at the approximately physiological temperature of 37°C.

The experiments on yeast and rat tissues recorded here demon-

strate that the metabolic stimulating effects of dihalophenols and trihalophenols, which are relatively insignificant in the higher temperature ranges, are more readily recognized at lower temperatures. These experiments are also of interest in connection with the elucidation of the mechanism of oxidation stimulation. This subject will be more fully discussed at a later date.

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Further Observations on the Function of Supernumerary Fingers in Man.*

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In a previous communication by one of the authors,[1] the results of a study of finger movements in a reduplicated human hand, originally described by Halverson and Amatruda,[2] were reported. The supernumerary fingers 3, 4 and 5 exhibited a decided tendency to be moved each one in association with the corresponding normal finger. Recently, after an interval of 8 months, at the beginning of which the patient had been instructed as to how to attempt to acquire the independent use of homologous fingers, the case was reexamined.

Kymographic records by means of torsion wire levers were taken simultaneously from 4 fingers, the normal 3rd and 4th and the supernumerary 3rd and 4th, the lower arm being fixed in pronation or supination. In spite of the marked tendency of all fingers except the unpaired index to move en masse, it was noticeable that during random movements, as well as in attempts to counteract the passive extension or flexion of a given finger, homologous fingers would contract in unison, much in the way described in the former communication. It was equally clear, however, that *independent* movements of each finger of a homologous pair could also be obtained, provided the girl was brought to focus her attention on the task of dissociating. Then, normal 3rd and supernumerary 3rd

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1 Weiss, Paul, PROC. SOC. EXP. BIOL. AND MED., 1935, **33**, 426.

2 Halverson, H. M., and Amatruda, C. S., *J. Gen. Psychol.*, 1935, **13**, 140. Similar case described by Dwight, T., *Anat. Anz.*, 1893, **8**, 60.