vidual effects upon the fundamental properties of growth, ρ, λ, κ, E. At that stage it will have become apparent whether a suitable choice of the x's will permit growth to be placed under full control or not.

Summary: (1) Post-embryonic growth of common laboratory animals is governed, in accordance with the first of equations (1), by 4 fundamental properties of growth represented by the constants ρ, λ, κ, and E. (2) Rates of growth ($\dot{q}$) are altered when any one, or suitable combinations of these parameters are changed by experimental means. In practice, however, the problem is more likely to be the converse of this: which parameters are changed when the normal or control rate of growth is known to have been altered? Such a problem is insoluble so long as observations are limited to measurements of change in size, z, alone. (3) Heat production "during growth" ($\ddot{q} \neq 0 \neq \dot{q}$) is quantitatively different from heat production when growth is in the stationary state ($\ddot{q} = \dot{q} = 0$). Heat production per unit time per unit mass is synonymous with metabolism, and the latter is dynamically related to growth *via* the properties represented by ρ and E_o. (4) The values of all constants along with their *P.E.*'s can be computed from simultaneous data on growth and metabolism. (5) The effect of any foodstuff, or of any procedure that influences growth can therefore be estimated in terms of the control values ρ_o, λ_o, κ_o and $(E)_o$, and the substances themselves may be compared by means of the respective changes induced in these four fundamental parameters of state.

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Effect of Certain Physical Factors on the In Vitro Testing of Anthelmintics.*

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Although certain investigators have done much to destroy confidence in the value of *in vitro* methods of testing anthelmintics by drawing too sweeping conclusions from uncontrolled experiments, these methods are of value and were used successfully by Lamson

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et al.[1] in their studies on the alkyl resorcinols. These studies have resulted in the establishment of hexyl resorcinol as an effective ascaricide of relatively low toxicity. This method of *in vitro* testing of ascaricides is described elsewhere,[2] but there remains for discussion certain physical factors which must be guarded against if reliable results are to be obtained.

As Lo Monaco[3] has already shown with santonin, an undissolved excess of the drug must be present in the testing solution for the best results, but he makes no mention of the effect of the physical state of the excess. However, a solid excess is far less effective than a liquid excess as will be shown. If certain substances, such as heptyl resorcinol, are allowed to stand for sometime in contact with 1,000 parts of 0.9% NaCl solution at 37° C., a part of the chemical will be dissolved, but as these substances are less soluble than 1 to 1,000 a solid excess will remain. If another sample of this same chemical is heated in contact with the same relative amount of 0.9% NaCl and cooled to 37° C. we shall have 2 mixtures of the drug and saline with the sole difference that in one instance the undissolved excess is a solid, while in the other it is a supercooled liquid. When these 2 mixtures are tested against *Ascaris lumbricoides* of swine, it is found that the one with liquid excess will kill the worms in a much shorter time. Table I records the results obtained when several of these substances were tested with both a solid and a liquid excess.

But many solids which have possible uses as anthelmintics will not remain liquid when cooled to 37°. It has been necessary to adulterate these higher melting substances with some organic liquid to keep them in the liquid phase. Many liquids have been tried in this laboratory with that purpose in mind, but usually the dilutant was either toxic to the worms or it inhibited to some degree the activity of the drugs being tested. n-Hexane has served this purpose better than any other chemical as it is non-toxic to the worms and has comparatively little effect upon the drug to be tested. Table II shows the results obtained when solid substances are liquefied with n-hexane.

It is well known that the molecules of a substance in a liquid state are much more motile than molecules of the same substance in a solid state. In the former case they are in no particular relation to one another but may freely move about in the liquid mass,

[1] Lamson, P. D., Brown, H. W., Ward, C. B., and Robbins, B. H., PROC. SOC. EXP. BIOL. AND MED., 1930, **28**, 191.

[2] Lamson, P. D., Brown, H. W., and Harwood, P. D. In Press.

[3] Lo Monaco, *Arch. ital. de Biol.*, 1896, **26**, 216.

TABLE I.

Drug	Melting point	Exposure necessary to kill *A. lumbricoides* in solid excess	liquid excess
		min.	min.
1-propyl naphthol-2	57°	10	2-5
2-propyl naphthol-1	49°	30-45	10-20
amyl resorcinol	71.5-73°	15	2
heptyl "	73-74.5°	5-10	2
o-phenyl phenol	56°	20-60	5

TABLE II.

Drug	Melting point	Amount of n-hexane	Exposure necessary to kill *A. lumbricoides* with pure drug	adulterated drug
		%	min.	min.
p (3 amyl) phenol	75.5-76°	⅓	20	2
cyclo hexyl resorcinol	128°	1	180	2
p tertiary amyl phenol	93-94°	1	20	2
p tertiary butyl "	97-98°	1	20	2
p chlorothymol	64°	⅓	20	5

while molecules in a solid have certain more or less definite positions relative to their neighbors and are accordingly, more restricted in their movements. A liquid will, therefore, dissolve much more rapidly in another liquid than the same substance in a solid state would dissolve in the same solvent. With these slightly soluble anthelmintics the removal from the test solution of a small amount of the drug would appreciably lower the degree of saturation. With a well agitated mixture this situation would be rapidly remedied if a liquid excess of the drug is present. However, a solid excess with its less motile molecules would be much slower in replacing the removed drug, and the test animals would be exposed to a much lower concentration of the drug. Furthermore, a liquid excess would be able much more readily to penetrate directly into the worm without passing through a dissolved phase than would be the case with a solid excess.