Soc. **80**, 2909 (1958); C. O. Thomas and H. A. Smith, *J. Phys. Chem.* **63**, 427 (1959)] have approached G. L. C. deuterium analysis by separation of the isotopes. Since this involves partitioning the deuterium under two peaks rather than converting it to one measurable species, and usually requires conditioning of the stationary phase between samples, we feel that our method is inherently better, precisely because we do *not* separate the gases.

5. We thank the National Science Foundation for supporting this work, and Mr. Lloyd Guild of the Burrell Corp. for advice. This report was presented 2 March 1960 at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy.

23 February 1960

Inheritance of a Serum Protein in Swine

Abstract. A study of polymorphism of the starch-gel electrophoretic pattern for one of the blood serum proteins in swine (tentatively designated protein B) reveals that it is controlled by a single pair of alleles exhibiting partial dominance. *BB* genotypes appear to have twice the amount of protein B that the *Bb* genotype has, while *bb* genotypes show no evidence of the protein. Present indications are that the Yorkshire and Landrace breeds differ in the frequency of these genes.

Inherited variations of serum proteins in human beings have been studied by Smithies and Walker (*1*) and in cattle by Smithies and Hickman (*2*) and by Ashton (*3*). Starch-gel electrophoresis of pig serum was reported by Ashton (*4*) without any genetic study of the polymorphisms observed.

In this investigation, serum samples from all the parents involved in 100 litters and from random samples of progeny in these litters were subjected to vertical starch-gel electrophoresis (*5*), and the resulting electrophoretic patterns were related to pedigree information in order to determine whether the polymorphism observed was under genetic control. Blood was collected from the ear veins on sows and boars, and by cardiac puncture from 28-day-old pigs. Serum samples were stored at −25°C.

The vertical starch-gel electrophoresis technique used in this study was essentially that of Smithies (*6, 7*), with the following differences. The buffer was made up with 125 ml of 0.2*M* tris(hydroxymethyl)aminomethane (Fisher) to which was added 62.5 ml of 0.1*N* HCl and 312.5 ml of distilled water. Seventy grams of Starch-Hydrolysed (Connaught Medical Laboratories, Toronto) and 500 ml of Tris buffer were used to prepare each gel. The electrophoresis was carried out at a voltage gradient of 5 volt/cm for 17 hours.

After staining and destaining, gels were photographed on 4 by 5 inch Kodak Verichrome Pan film with a Wratten filter F. Contact prints were used as a permanent record of each gel.

Figure 1 illustrates the types of electrophoretic patterns which were observed for the protein tentatively designated as protein B.

The analysis of the data gathered to date with respect to protein B is presented in Table 1. As indicated by the probability values, χ^2 tests support the hypothesis that phenotypes I, II, and III result from genotypes *BB, Bb,* and *bb,* respectively. The poorest fit was noted for progeny from the II × I matings. This suggests the possibility of a semilethal interaction between a *Bb* genotype in the progeny and a *BB* genotype in the dam.

In order to examine this possibility further, a heterogeneity χ^2 test was carried out for the progeny distributions resulting from the I × II and II × I mating classes. The results ($\chi^2 = 1.371$, $P > .20$) indicated that both mating classes were likely samples from a single population of matings which produces segregation in a 1:1 ratio. Further data will be required to determine whether this deviation has any real significance. When progeny totals from I × II and II × I mating classes are pooled, the fit to a 1:1 ratio is quite reasonable ($\chi^2 = .371$, $P > .50$).

Among the 100 litters involved in this study, 38 were Yorkshire × Yorkshire, 16 were Yorkshire × Landrace, 32 were Landrace × Landrace and 14 were Landrace × Yorkshire (males are identified first). Of particular interest is the distribution of genotypes among sows of each of the breeds (Yorkshire 22 *BB,* 27 *Bb,* 3 *bb;* Landrace 46 *BB,* 2 *Bb,* 0 *bb*).

The application of a χ^2 test for uniformity of genotype distributions among sow herds ($\chi^2 = 33.093$, $P < .01$) indicates that the genotype distributions, and therefore the gene frequencies, are significantly different. This is particularly interesting since the Landrace sows represent samples from 29 different Ontario breeders and the Yorkshire sows are descended from a wide sample of dams and 15 unrelated boars purchased from 12 different Ontario breeders during the past 3 years. The distribution of genotypes among Yorkshire boars involved in this study was 2 *BB,* 3 *Bb,* 0 *bb,* and among Landrace boars, 4 *BB,* 0 *Bb,* 0 *bb.* It is tentatively concluded that the Yorkshire and Landrace breeds differ markedly in frequency of the genes controlling development of serum protein B (*8*).

Table 1. Distribution of observed progeny phenotypes (o) from various mating classes and those expected (e) on the hypothesis that phenotype I = *BB,* phenotype II = *Bb,* and phenotype III = *bb.*

Item	Progeny phenotypes I (*BB*)	II (*Bb*)	III (*bb*)	*P* of χ^2
	Mating class I × I			
o	109			
e	109			
	Mating class I × II			
o	25	26		
				>.80
e	25.5	25.5		
	Mating class I × III			
o		7		
e		7		
	Mating class II × I			
o	34	24		.10–
e	29	29		.20
	Mating class II × II			
o	24	47	27	
				>.80
e	24.5	49	24.5	
	Mating class II × III			
o		3	1	
e		2	2	
	Totals			
o	192	107	28	
				>.80
e	188	112.5	26.5	

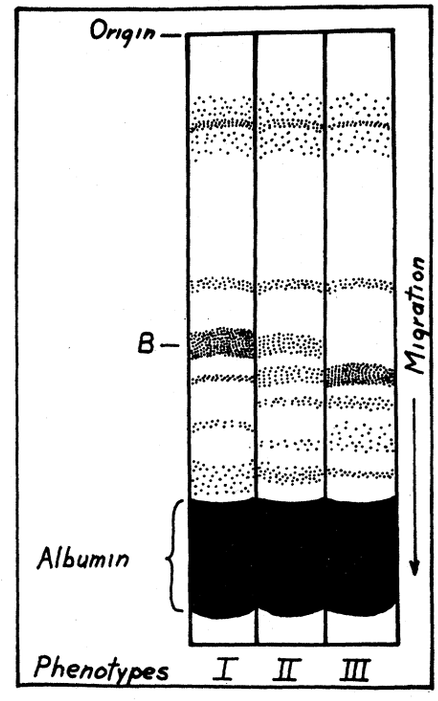

Fig. 1. Diagrammatic illustration of electrophoretic patterns showing the variants observed for protein B. Additional variation to that illustrated has been observed for other proteins.

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References and Notes

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3. G. C. Ashton, *Nature* **180**, 917 (1957).
4. ———, *ibid.* **179**, 824 (1957).
5. I wish to thank W. Zeitz for his technical assistance in the electrophoresis work involved in this study.
6. O. Smithies, *Biochem. J.* **61**, 629 (1955); **71**, 585 (1959).
7. I wish to express my thanks to O. Smithies for his interest and advice on vertical starch-gel electrophoresis.
8. This report is contribution No. 16, Animal Research Institute, Research Branch, Canada Department of Agriculture.

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