

Academic Research Origin: M. R. Irwin's Laboratory in Classical Immunogenetics
University of Wisconsin, Madison.

Research Discoveries and Contributions:

1. Established that antibodies are not mutagens (contrary to Guyer's proposal), using anti-lens in rabbits.
2. Showed that development of species-specific antigens may have a "gap", e.g. AF of C. guinea.
3. Showed a displacement or replacement and non-simultaneous development of adult antigenic factors in cattle (with Hubbert).
4. Developed "Miller's principle of antithetical antigens": A-A', B-B', C-C', E-E' ...
5. Taxonomic implications for species-specific antigenic relationships reveal that they may be identical, related, or unique (with Irwin), and may exist as phenogroups.
6. Explained the "hybrid substance" as an interaction product dependent on particular antigens in heterozygous state and on interacting non-allelic loci heterozygous and homozygous in a species, e.g. CC', hu-4//hu-8.
7. Developed the cloacal method for sexing doves and pigeons - 30 species.
8. First to list behavior traits in the ringneck dove.
9. Demonstrated the hormonal control of sexual dichromatism in the dwarf turtle dove.
10. Performed genetic analysis of 55 genetic characters in Streptopelia risoria, ringneck dove, and discovered mutants:

heel walker	pigeon-	recessive
flare	dove	- recessive, in juveniles
stubby dwarf	dove	- recessive
silky plumage	dove	- partial dominant (gene symbol L)
thin bill ring	dove	- partial dominant
yellow down	dove	- recessive(?)

Assisted in the analysis of pigeon mutants: (with Hollander)

amputated toes	-	recessive
fray plumage	-	partial dominant
sideburns	-	partial dominant
web-lethal	-	sex-linked
		recessive
11. Conducted dihybrid testcrosses for linkage of several characters including 4 species-specific antigens and albumin of S. risoria and S. humilis. There were two linkage groups found: L 8 hu-8 ; alb-H 21 hu-y
12. Found heterosis in antibody production - Pheasant-Turkey hybrids (with Wolfe).
13. Found bacterially mediated false-positive reactions in blood typing tests in vitro (with Stormont), and an in vivo influence by Salmonella in red cells of pigeons.

14. Assisted (with Draper) in the analysis of spinal dysraphism in dogs which is a dominant with reduced penetrance and variable expressivity.
15. Dogs have blood type phenogroups; and a dog reagent in humans showed type AB have mandatory pairing on bifurcated chains (with Steiler).
16. Made rather extensive cross species comparisons showing that naturally occurring antibodies are highly frequent in cross-species tests, and that natural cattle U' (with Stone) is a U_1U_2 subtype heterozygote detector.
17. Showed that cattle have a neonatal hemoglobin; that fetal cattle have 4 fetoproteins; that fetal cattle have mostly non-IgG antibodies, since 2 ME inactivated them (with Hubbert).
18. Started turkey blood typing.
19. Demonstrated that recessive antigens are more widespread than generally believed (with Fischer).
20. Was among the first to apply gel electrophoretic character -polymorphism to wild species, e.g. the white-tailed deer, using hemoglobin and transferrin differences (with Haugern & Roslien).
21. First to list the criteria for blood typing reagents.
22. Increased the B phenogroups of cattle from 120 to 300+.
23. Showed that buffalo - bison (typed with cattle reagents) may show some of the cattle individual differences as species-specific antigens: L, including dual alternative specificities (heterozygotes) R'S'; as a species-specific antigen (homozygotes)!
24. Demonstrated (with Stormont) that bison show individual and species-specific antigens in the same system, breaking the then current dogma! specifically:

$$\begin{array}{r} C_2 \ W \ X_1 \\ \quad \quad W \ X_1 \\ \quad \quad \quad \quad X_1 \end{array}$$
25. Characterized blood types (especially phenogroups) in several breeds of cattle: Longhorn, Caracu, Gir, Nelore, Guzerat, and further developed that in Ayrshire, Brown Swiss, Jersey, Guernsey, Holstein-Friesian, Aberdeen Angus, Hereford, and Shorthorn.
26. Found new systems N and R'-S', and several new factors in cattle blood typing.
27. Showed that subtypes are asymmetrical blood typing reactions widely and extensively present. They may be (1) Linear.
(2) Non-linear.
(3) Quantitative and Qualitative.
28. Screened guanacos for suitability in blood typing and for taxonomic relationships.
29. Performed extensive lectin tests among and within species finding similarities and differences with antibodies.
The peanut extract gives a recessive reaction in ringnecks.
Maackia is antithetical to peanut in ringnecks.
Wisteria extract is a juvenile character and shows a cluster effect!
Lectins may be fractionated by absorptions, breaking the then current dogma.