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This Week's Citation Classic

Reisfeld R A, Lewis U J & Williams D E. Disk electrophoresis of basic proteins and peptides on polyacrylamide gels. *Nature* **195**:281-3, 1962. [Merck Sharp and Dohme Research Labs., Rahway, NJ]

Polyacrylamide gel electrophoresis has been modified to make possible the separation of basic proteins and peptides. This technique permits excellent resolution with samples as small as 50 µg and within as little as 20 minutes. Crystalline trypsin was shown to contain a minor component with the mobility of chymotrypsin. Basic proteins and peptides also shown to contain more than one electrophoretic component include ribonuclease, protamine sulfate, globin, and lysine vasopressin. [The *SCI*® indicates that this paper has been cited over 1,765 times since 1962.]

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"One of the more exciting biochemical developments in 1960 was the appearance of acrylamide gel electrophoresis or 'disc electrophoresis,' a term coined by Leonard Ornstein and B.J. Davis at Mt. Sinai Medical Center, New York, who were instrumental in developing this procedure.[1,2] I met Ornstein by chance in 1961 and became immediately fascinated by the sensitivity, simplicity, and elegance of disc electrophoresis for the analysis of proteins and peptides. I was indeed so highly impressed by the discriminatory powers of this procedure that I convinced my colleagues, U.J. Lewis and Don E. Williams, who at that time worked with me at Merck, Rahway, New Jersey, to visit Ornstein and Davis at Mt. Sinai Medical Center and to let them show us how to perform disc electrophoresis. My colleagues and I immediately started to use this method, which aided us considerably in efforts to purify and to characterize pituitary hormones. It is difficult to describe the excitement, expectation, and sometimes frustration in those early years, when we watched the destaining' of the gels and the appearance of one or multiple components on the polyacrylamide gels.

"As an illustration that a powerful method can sometimes be performed by simple and inexpensive means, it is worthwhile to mention that, following Ornstein's and Davis' example, we prepared our original electrophoresis apparatus from components bought literally at the 'five and dime store,' utilizing the carbon rods from old flashlight batteries as electrodes. In fact, Ornstein and Davis in the early phase of their work had to run from the basement of the hospital to the roof in order to get enough sunlight (not always easy to find in New York City) to aid the catalysis of polymerization of the 'stacking gels.'

"We were stimulated to develop our method by demands of colleagues who wanted to analyze basic proteins which could not be resolved in the Ornstein-Davis system which had a 'running pH' of 9.6.

"When I left Merck in 1963 to join the laboratory of immunology at the National Institutes of Health (NIH), I was indeed for-tunate to get there at a very exciting time in the field of immunology, i.e., when there was an intensive effort made by some excellent and imaginative investigators to resolve the complex structure of the antibody molecule. I was fortunate to be among the first to introduce disc electrophoresis to the field of immunology and to be able to utilize this powerful technique to gain some knowledge about the immunoglobulins. I also was privileged to be able to teach disc electrophoresis techniques to many bright and imaginative young scientists at NIH who then used it to excellent advantage. The disc electrophoresis technique has over the years become an even more versatile, useful, and powerful research tool, especially through the work of J. Maizel at Albert Einstein College of Medicine, who introduced the use of ionic detergents to estimate molecular weights,[1] and also through the sustained and imaginative efforts of my former colleague, Andreas Chrambach at NIH, who together with his associates, T.M. Jovin and D. Rodbard, vastly expanded and improved the applicability of the method, and developed its underlying theoretical principles to put it on a sound mathematical basis."[4,5.]

1. **Ornstein L.** Disc electrophoresis—I—background and theory. *Ann. NY Acad. Sci.* **121**:321-49, 1964.
2. **Davis B J.** Disc electrophoresis—II—method and application to human serum proteins. *Ann. NY Acad. Sci.* **121**:404-27, 1964.
3. **Maizel J V.** Mechanical fractionation of acrylamide gel electropherograms: radioactive adenovirus proteins. *Science* **151**:988-90, 1966.
4. **Rodbard D & Chrambach A.** Estimation of molecular radius, free mobility, and valence using acrylamide gel electrophoresis. *Anal. Biochem.* **40**:95-134, 1971.
5. **Jovin J M, Dante M L & Chrambach A.** *Multiphasic buffer system output.* Springfield, VA: National Technical Information Service. 1970. PB 196085 to 196092.