0.16 and 0.40 μc and probably represents the loss owing to self-absorption of the beta-particle energy. These values are, of course, valid only for the particular counting system used in this series of experiments. It is possible to make the detection system considerably more sensitive and, therefore, reduce the threshold value for skeletal strontium.

The afore-described method has not yet been tried with other fission products, and in particular, mixed fission products, such as might be encountered in an area following an atomic detonation or in a region into which nuclear power plant wastes are introduced. If a parameter such as that indicated in this paper could be used to predict the total amount of radioactive material in marine fish, it might be feasible to monitor a catch on the fishing vessel or at the canning factory and, thereby, possibly prevent radioactive fish from being consumed.

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9 August 1956

Protein Adsorption on Filter Paper

Protein adsorption on paper is one of the main obstacles in the determination of mobilities by paper electrophoresis, since ion interaction with the supporting medium decreases the migration rates. As surface-active substances, the proteins assemble at the solvent-cellulose interface, and their adsorption behavior will be determined primarily by electrostatic forces between the ion and the negative charge on the paper. The latter would be due to a selective absorption of oxhydrilions from the medium, which accounts for the negative charge on most nonionogenic surfaces in water (*1*). Carboxyl groups that probably originate by an oxidation of primary alcohol groups during the paper manufacture (*2*) may also play a role in this connection. It follows that the paper charge, and the electroosmotic flow arising from the zeta potential thus produced, should increase with the *p*H. In fact, in electrophoretic analyses where dextran was employed to measure the electroosmotic flow (*3*), we found that the migration tended to increase in approximate proportion to the *p*H from *p*H 4.0 to 7.0.

Pretreatment of the paper in order to avoid adsorption has been attempted (*4*) but so far has not met with success. We therefore introduced, among other factors, a correction for this effect in the calculation of electrophoretic migration rates and found complete agreement between the mobilities determined by open-strip paper electrophoresis and those obtained by the Tiselius method (*3*).

Chromatographic R_f values were chosen to evaluate adsorption, since protein migration would not be subject to any forces other than the solvent displacement by capillary action (*5*). Ten microliters of dialyzed solutions of normal human albumin ($5 \times 10^{-4} M$) and gamma globulin ($2 \times 10^{-4} M$) were applied on 3- by 49-cm strips of Munktell paper No. 20/150 2,5 cm above the buffer level, after 18 hours of equilibration (*6*). Sodium and zinc acetate buffers of Γ/2 0.045 were used as part of our studies on protein-zinc interactions, and the ascending chromatograms were developed for 120 minutes at 23°C, after which they were stained and scanned, as in electrophoresis. Each of the points recorded represents the mean of four determinations with a maximal variation of about 5 percent.

The R_f minima of albumin (Fig. 1) indicating maximal adsorption at *p*H 4.85 in sodium and at *p*H 6.00 in zinc acetate coincided with the isoelectric points in the same media as found in our electrophoretic analyses. This is in accordance with the early literature on this subject dealing with adsorption on collodium and charcoal (*7*). Gamma globulin, however, showed in sodium acetate a broad R_f minimum constant from *p*H 4.0 to 6.8, the upper limit of which roughly corresponds to the isoelectric point. Analogous results for immune globulin were obtained by Shepard and Tiselius (*8*) from studies on silica gel.

Under the conditions employed, gamma globulin was more strongly adsorbed than albumin in sodium buffer. The difference amounts to 4.5 percent at *p*H 5.0 and increases to above 10 percent toward the extremes of the experimental *p*H range. When, in order to establish conditions prevailing in the whole serum, 1 ml of albumin solution was added per 100 ml of buffer at *p*H 4.05, gamma globulin adsorption fell to the albumin level, evidently owing to a partial neutralization of the paper charges by albumin. The implications of this fact are discussed in another report (*3*).

The fundamental role of electrostatic interactions in adsorption is emphasized by experiments with a practically nonionized substance as dextran. Whereas for a 4-percent aqueous dextran solution we found R_f values of 0.98 ± 0.02 throughout the whole series, Tiselius (*4*) points out that salmine, which mainly bears strongly ionized cationic groups, is so firmly held by paper in electrophoresis that "tailing" impedes the observation of compounds with lower mobilities.

Moreover, when the electrostatic factor is stressed, the results indicate that the protein net charge is of secondary importance in the interaction with paper centers, which will be sustained by the cationic groups of the protein. The reason for the adsorption falling off in strongly acid media will thus be the low charge on the paper, and its decrease above the isoelectric point of the protein will be due to the diminution of the positive protein charge. Hence, adsorption will be maximal in a zone around the isoelectric point, where it could be further enhanced by the decrease of the zeta potential, which produces a lessening of the intermolecular repulsion.

The increment of positive protein charge by formation of zinc complexes may thus be considered the main reason for the difference between R_f values in zinc and sodium acetate. Adsorption at the same *p*H's was seen to be signifi-

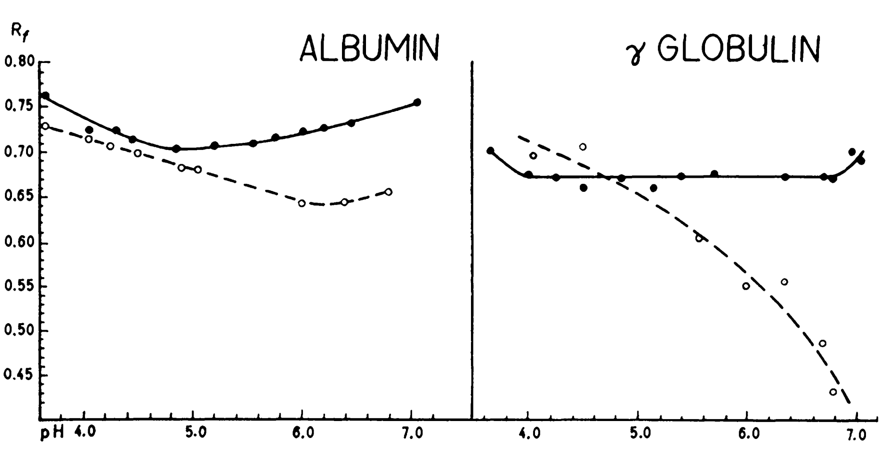

Fig. 1. R_f values of human serum proteins in sodium (● ——●) and zinc (○ - - - ○) acetate as function of the *p*H.

cantly higher in the former, and the difference increased substantially above *p*H 5.0 toward the zone known to favor intense protein-zinc interactions.

After rigorous standardization of the experiments, the results were reproducible within 1-percent variation, and the values may be regarded as one of the physicochemical constants of a protein.

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Peralta Complex—a Sonoran Variant of the Cochise Culture

Last year I reported on the examination of seven camp sites west of Hermosillo, Sonora, Mexico, that represented a prepottery, lithic complex very similar in type to the Cochise culture of southeastern Arizona (*1*). This material is most comparable to the San Pedro stage of the Cochise, which in Arizona has been dated approximately 3000 to 500 B.C.

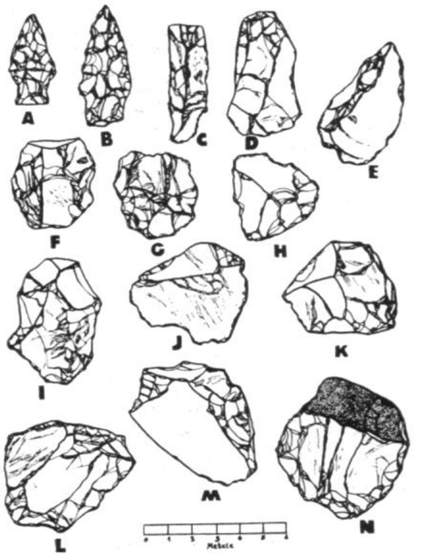

Fig. 1. Artifacts from the "Peralta" Cochise, Sonora: *A, B,* projectile points; *C, D, I,* end scrapers; *E, J, K, M,* single flakes; *F, G, H, L,* side scrapers; *N,* cobble end chopper.

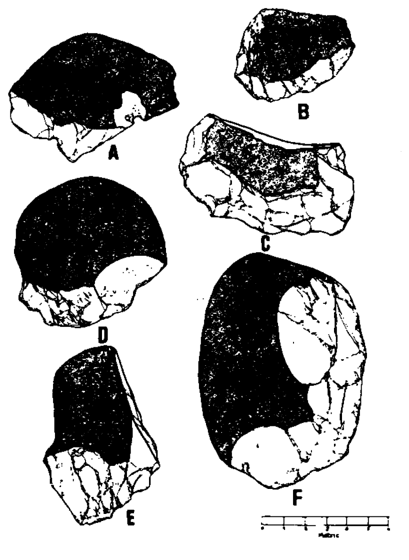

Fig. 2. Several examples of the cobble choppers, the shapes of which are similar to those of the southeastern California region.

During the summer months of 1955, as a research associate of the Instituto Interamericano, I instigated an archeological research program in western Mexico (*2*). The field survey was concentrated primarily along the coasts of Guerrero and Colima and in northern Nayarit; other limited investigations were undertaken in Michoacán, Guanajuato, Jalisco, and Sinaloa. Near the conclusion of the survey, several additional areas were investigated in western Sonora to complement previous studies; as a part of this survey, four of the principal Peralta sites were revisited.

During the original 1953 survey, seven camp sites were located, with the subsequent collection of 146 stone artifacts. These included percussion-flaked side and end scrapers, crudely flaked knife blades, large primary flakes, cobble choppers, and occasionally projectile points, the latter comparable to the San Pedro stage of the Cochise and to the Pinto-Gypsum points of California.

As a result of the 1955 investigation, another collection of 126 stone artifacts was made, primarily to collect all the available surface material before the possible loss of the sites to pending cultivation (Figs. 1 and 2).

In addition, three new, though skimpy, sites were located in the same area, and 36 more specimens were found. Thus, to date, a total of 308 artifacts have been collected from the entire site area. Scheduled plans for a 1957 survey will test-excavate several of the more important sites, and the entire surrounding region will be completely surveyed to ascertain the extent of the distribution of the material.

Surface finds made during the 1955 survey included material similar to that previously described in the preliminary report (*1*). However, in the second survey, I was fortunate to locate fragments of two metates, none of which had been encountered previously. These fragments indicate two milling types: (i) a shallow basin made of granite and (ii) a smaller, thin, flat slab made of shale. Numerous one-handed, asymmetrical, bifaced manos were found, during both seasons, scattered over most of the surface area.

A brief, preliminary tabulation of the variety of types of artifacts presently discernible from these ten sites is given in Table 1.

Table 1. Types of artifacts.

Artifacts	Sites										Total
	A	B	C	D	E	F	G	H	I	J	
Metates			1	1							2
Manos (including fragments)		2	4	21	5	2	5		4	2	45
Projectile points			6	2	1	1	1				11
Knife blades			24	23	6	1					54
Scrapers	3		26	28	10	8	2	4	3	2	86
Crude primary flakes			8	11	16		6	7	2	1	51
Cobble choppers			5	12	9		2	2	4		34
Miscellaneous			2	15	2	1	2	2		1	25
Total	3	2	76	113	49	13	18	15	13	6	308

The artifacts will be deposited with the Biblioteca y Museo de Sonora in Hermosillo (Fernando Pesqueira, director), when the study is completed.

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