acetone/ether decreased absorption/retention capacity. (2) Friberg et al. (13), however, considered that protein might also play an important role in SC water retention. They found that the additional water absorbed after re-aggregation of equilibrated lipids and proteins was equally partitioned between the protein and the natural lipid fraction of the human SC. (3) Middleton (14) considered that water-soluble substances were responsible for water retention and for most of the extensibility of the corneum. He found that powdered SC—but not the intact corneum extracted by water—exhibited lower water retention capacity. He suggested that the powdering procedure ruptures the walls of the corneum cells and allows water to extract the water-soluble substances without a prior solvent extraction. We measured the water retention capacities of untreated PHSC, delipidized PHSC (as the protein fraction), and the lipid content by measuring the amount of [3H]-water (microgram equivalent) per milligram PHSC after equilibration. As shown in Table 5.1, no statistical differences ($p > 0.05$) were observed for untreated PHSC, delipidized PHSC, and the combination of delipidized PHSC and the lipid content. The PHSC can absorb up to 49% by weight of dry untreated PHSC (Table 5.1), which is consistent with literature reports. Middleton (14) found that the amount of water bound to intact, small pieces and powdered guinea-pig footpad stratum corneum was 40%, 40%, and 43% of dry corneum weight. Leveque and Rasseneur (15) demonstrated that the human SC was able to absorb water up to 50% of its dry weight. Our results (Table 5.1) suggest that the protein domain of the PHSC plays an important role in the absorption of water. Depletion of the PHSC lipid content did not affect water retention (16).

5.3 PHSC AND CHEMICAL PARTITIONING

Table 5.2 shows the effect of varying initial chemical concentrations on the partition coefficient (PC) PHSC/w of these compounds (16). Under fixed experimental conditions—two-hour incubation time and 350°C incubation temperature—the concentration required to attain a peak value of the PC varied from chemical to chemical. After reaching the maximum, increases in the chemical concentration in the vehicle did not increase the PC value; rather, it slightly decreased or was maintained at approximately the same level. This is consistent with the results of Surber et al. (3, 4) on whole SC. Chemical partitioning from the vehicle into the SC involves processes in which molecular binding occurs at certain sites of the SC, as well as simple partitioning. Equilibration of partitioning is largely dependent on the saturation of the chemical binding sites of the SC (3, 17). The results also indicate that, under a given experimental condition, the maximum degree of partitioning was compound specific. As the SC contains protein, lipids, and various lower-molecular-weight substances with widely differing properties, the many available binding sites display different selective affinities with each chemical. Thus, the degree of maximum binding or of equilibration varies naturally with molecular structure (17). This result demonstrated that the solubility limit of a compound in the SC was important in determining the degree of partitioning, as suggested by Potts and Guy (5). On the basis of the solubility limit of a chemical, the absorption process of water-soluble or lipid-soluble substances was controlled by the protein domain or the lipid domain, respectively, or a combination of two (18). Since the lipophilicity of the lipid domain in the SC is much higher than that of water, a lipophilic compound would partition into the SC in preference to water. Thus, when water is employed as the vehicle, the PC PHSC/w increases with increasing lipophilicity of solute (19). Conversely, the protein domain of the SC is significantly more polar than octanol and governs the absorption of hydrophilic chemicals (18). For very lipophilic compounds, low solubility in water rather than increased solubility in the SC can be an important factor (19). Moreover, in addition to partitioning into these two domains, some amount of chemicals may be taken into the SC as the result of water hydration. This is the "sponge domain," named by Raykar et al. (18). They assume that this water, having the properties of bulk water, carries an amount of solute into the SC equal to the amount of solute in the same volume of bathing solution. Therefore, for hydrophilic compounds and some lower lipophilic compounds, the partitioning process may include both the protein domain and sponge domain.