2. Topical application of drug-loaded liposomes promotes delivery of the active ingredient to local tissues and, for at least some cases, may reduce systemic drug levels.
3. Transdermal and transocular delivery of lipophilic molecules is definitely enhanced by liposome incorporation.
4. Transdermal or transocular topical delivery of hydrophilic materials is considerably more problematic. Most small, membrane-impermeant markers show no improvement, yet the occasional success with some molecules like penicillin G suggests that more studies to discover structure–activity correlations are warranted.

It is perhaps not surprising that transdermal delivery of water-soluble membrane-impermeant compounds is further impeded by adding yet another permeability barrier, namely, the liposome. Certainly, there is no evidence for penetration of intact liposomes with their payload through the skin and, indeed, evidence to the contrary. Specific monitoring of radiolabeled phospholipid markers shows no evidence for phospholipid penetration through the skin under in vitro (47; Uster, unpublished data) or in vivo conditions (25). The penetration of intact liposomes through the stratum corneum can be likened to the probability of passing a basketball through a chain-link fence without rupturing it.

V. FUTURE DIRECTIONS

A. Basic Research

Topically applied, drug-loaded liposomes can substantially improve drug loading, drug delivery, and sustained release, thereby offering clearcut advantages over traditional dosage forms. These advantages are particularly evident for the more lipophilic active ingredients, in which elevated local concentrations are consistently demonstrated and that for, at least, some drugs reduces the systemic concentrations. Because there is no evidence for liposome penetration through intact topical surfaces, such as the stratum corneum, it is perfectly logical that water-soluble, membrane-impermeant active ingredients face an additional barrier to increased bioavailability when entrapped within liposomes. For topical surfaces, the structural integrity of which is not compromised, a second generation of liposome vehicles will have to be developed.

However, water-soluble drugs entrapped in conventional liposomes may play an extremely useful role in treating conditions in which the integrity of the stratum corneum or other topical surface has been damaged. The study by Smolin and co-workers on viral infection of abraded rabbit corneas is especially encouraging (33).