

- (10) Krieger, I. M., and Maron, S. H., *J. Applied Phys.*, **23**, 147 (1952).
 (11) Cram, K. H., and Whitwell, J. C., *Ibid.*, **26**, 613 (1955).
 (12) Mooney, M., and Ewart, R. H., *Physics*, **5**, 350 (1934).
 (13) Pochetino, A., *Nuovo Cimento*, **8**, 77 (1914).
 (14) Bergen, J. T., Patterson, W., Jr., *J. Applied Phys.*, **24**, 712 (1953).
 (15) Wachholtz, F., Asbeck, W. K., *Kolloid-Z.*, **93**, 280 (1940); *ibid.*, **94**, 66 (1941).
 (16) Asbeck, W. K., to be published.
 (17) Merrill, E., *J. Colloid Sci.*, **9**, 7 (1954).
 (18) Asbeck, W. K., J.aiderman, D. D., and VanLoo, M., *ibid.*, **7**, 306 (1952).

FUNDAMENTAL AND COMPARATIVE ACTIONS OF CLEANSING CREAMS*

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ALTHOUGH CLEANSING creams are purported to produce a number of beneficial effects upon the skin, their primary effect and fundamental use is as cleansing agents. The nature of this cleansing action has not been clear particularly in view of the fact that plain soaps are said to be equally effective in removing dirt and other foreign matter from the surface of the skin. However, since it is unlikely that cleansing cosmetic preparations would have received continued use for centuries in the absence of superior cleansing action, the cosmetic chemist has justly accepted the presence of superior cleansing properties and has formulated his products more or less on an empirical basis. It is the purpose of this paper to present hitherto unreported observations concerning the effects of cleansing creams and other products upon a specific type of natural skin soil, namely, upon sebum which has *solidified* in the form of "plaques" over the sebaceous or pilosebaceous orifices. The studies to be presented are preliminary in character and have been conducted as a matter of experimental orientation; it is hoped that the findings may serve as a guide to the refinement of less subjective techniques.

While pursuing studies along unrelated lines, we confirmed the published observation that the sebum lying in the exit of the sebaceous duct fluoresces white to yellow or orange when illuminated by filtered ultraviolet light. However, we also observed that the majority of the yellow and orange fluorescent points consisted of sebum which had solidified in the form of a "cap" loosely covering, but nevertheless adhered to, the surface opening of the sebaceous gland. These caps, or plaques, could be pried loose with a sharp instrument such as a scalpel or razor blade and

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were surprisingly resistant to removal by scrubbing with soap and water. They were not grossly apparent under ordinary conditions of illumination. Although present over most of the body surface, these sebal plaques were most numerous on protected areas such as the chest or back and on those areas subject to drying and cold such as the forehead, cheeks or chin. They have been consistently found to be present on the facial skin of men and much less frequently on the facial skin of women. (It is of further interest to note that solidified sebum was found in greater abundance on the facial skin of men who shave electrically than on those using lather and razor.)

These sebal plaques have received scant attention in the published literature. Since their presence is incompatible with the presumed functions of sebum, the foregoing observations suggested the possibility that the efficacy of cleansing creams may lie in their ability to dislodge and remove these plaques from the orifices of the sebaceous ducts; initial experiments revealed such preparations to be more effective indeed than the common soap-and-water scrub. It was of interest therefore to determine if differences in the relative efficiencies of commercial preparations could be demonstrated and to further investigate the properties of some of the individual ingredients in the hope that the findings might confirm or shed light on the nature of the action of such cosmetic preparations. (It should be emphasized that the studies which follow were concerned with the removal of sebal plaques and not with the removal of the surface lipid layer of sebum; the latter is indisputably essential to the integrity of normal, healthy skin.)

EXPERIMENTAL

The skin of the normal female back was illuminated by filtered ultraviolet light (3600 Angstroms) and individual sites were chosen for study based on the presence of evenly distributed fluorescent sebum deposits. Each of four commercial cleansing creams was then applied to a 2 × 2 cm. gauze swatch and secured to the experimental site with adhesive tape. After a contact time of fifty minutes, the swatches were removed and the areas wiped dry with cleansing tissue. The treated sites were then examined for changes in the number of sebum deposits by comparison with adjacent untreated areas and scored visually as follows: zero, no effect; single plus, slight effect; double plus, marked effect; and triple plus, pronounced effect. Experiments were repeated at least five times using the cross-over experimental design with several subjects. The findings are presented in Table I and indicate that differences in efficiency, albeit minor in degree, could be detected by gross subjective observation among the four preparations.

It should be mentioned that plaque removal could be accomplished in a

matter of minutes by applying friction to the treated areas. Unfortunately, it was found difficult to apply the same uniform degree of friction to the several treated sites; also, such friction invariably resulted in a pronounced darkening of the area (under ultraviolet illumination only) thereby rendering the results difficult to evaluate. This procedure was therefore discarded for the purposes of the present investigation.

TABLE I

Product	Individual Scores					Average Score
Cleansing Cream A	++	++	+++	++	++	2.2
Cleansing Cream B	+++	++	++	++	++	2.2
Cleansing Cream C	+++	++	+++	+++	++	2.6
Cleansing Cream D	+++	+++	+++	+++	+++	3.0
Silicone grease	0	0	0	0	0	0
Salts	0	0	0	0	0	0
Milk	+	0	+	++	0	0.8
Span 20	+	+	+	+	0	0.8
Tween 85	+	+	+	+	0	0.8
Petrolatum	+	++	+	+	++	1.4
Lanolin, toilet	+	++	++	+	++	1.6
Hydrogenated Lard	++	++	+++	++	++	2.0
Polyethylene Glycol 400	+++	+++	++	++	+++	2.6
Olive oil	++	+++	+++	++	+++	2.6

Based on the findings obtained with the cleansing creams, similar experiments were conducted with a number of individual ingredients. The latter were chosen at complete random—those which happened to be conveniently on hand—and by no means were intended to represent a cross-section of ingredients commonly used. The findings, also presented in Table I, indicate a marked spread of efficacy among the products with oleaginous substances being the most effective.

In view of the known lipoidal nature of sebum, the solubilizing properties of a series of fat solvents were also studied. These included acetone, chloroform, glycerol, kerosene, white gasoline, dioxane, trichloroethylene and ethanol (95 per cent). Because of their topical irritant properties, extended applications were avoided; instead, they were applied to the skin by means of a saturated cotton swab and rubbed into the area for a period of sixty seconds. Surprisingly, none of these solvents was found to be effective in removing the solid sebum plaques; however, they effectively removed the surface oily layer rendering the treated areas dry and uncomfortable.

DISCUSSION

The sebaceous gland has been exhaustively reviewed by Rothman (1) and by Montagna (2) among others. From a physiological point of view, these glandular elements have been studied in reference to structure, dis-

tribution, mechanism of excretion and chemical composition of the excreted products. The glands are present in the skin over most of the body surface with marked regional differences in concentration and are apparently absent only in the palms, soles and foot. The excreted product is composed of lipids and cell debris and compositional studies have shown the lipids to contain both saturated and unsaturated fatty acids with *odd* numbers of carbon atoms and also to contain large quantities of *waxes* (3-5); lipids possessing such characteristics and such composition have not been found to exist elsewhere in the body indicating sebum to be synthesized through highly specific biochemical processes (6). From a pathological point of view, the sebaceous glands are immediately involved in the formation of comedones (blackheads) and in the development of seborrheic dermatitis, acne and various skin blemishes. Finally, from a functional point of view (1, 2), sebum is known to possess fungicidal (7) and bactericidal activities (8), to be involved in the normal keratinization process and to be an essential component in the radiation synthesis of vitamin D. Although these properties have not been completely elucidated, it is obvious that sebaceous glands, as one of the fundamental structural units of the skin, are essential to the maintenance of skin normality.

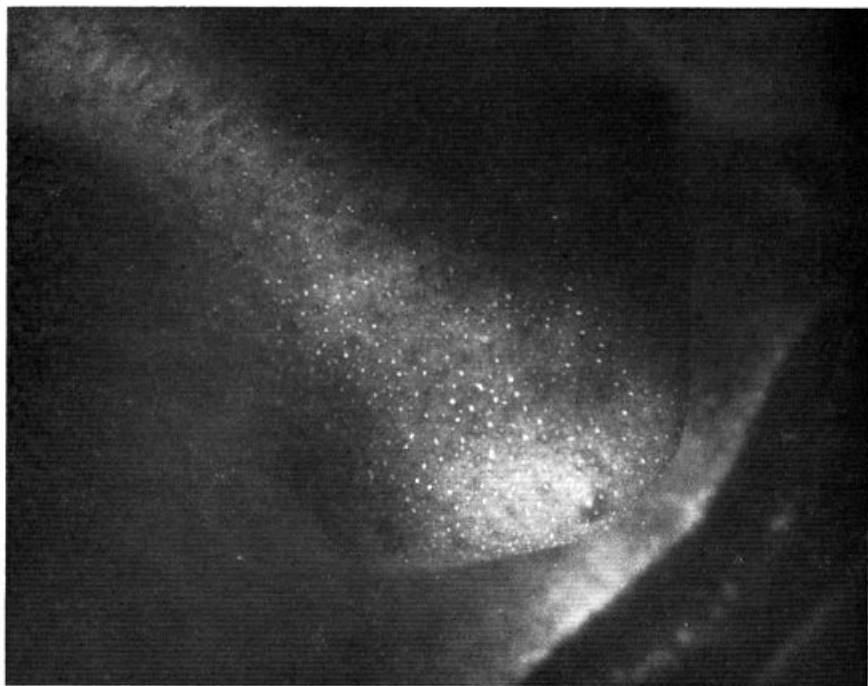


Figure 1.—The human female nose showing the fluorescence of sebum lying in and upon the surface ducts.

The observations reported herein demonstrate that in addition to the recognized lipid surface film affected by sebaceous gland activity, solidification of the excreted sebum occurs to the extent of forming a "cap" upon the surface aperture of the glandular duct. It is not within the scope of this paper to demonstrate the undesirability of such a situation nor to infer in any way that plugging of the sebaceous canal may occur as a consequence. However, it is pointed out that the existence of such plaques does not conform with any of the suggested concepts regarding the purposes and functions of excreted sebum. In view of the remarkable adherence of these plaques to the skin, it is not difficult to speculate that they might become local sites of bacterial growth followed by subsequent invasion of the glandular element itself (especially anaerobically); in this regard, it has long been known that excreted sebum may rapidly become rancid following deposition upon the skin surface.

Cosmetically, it is conceivable that inspissated sebum adheres to foreign soil with the same tenacity as it itself adheres to the skin. Under these conditions, cleansing with soap and water could hardly effect removal of this foreign debris as indicated by the studies reported herein. This, obviously is one of the major differences in cleansing action between soaps and

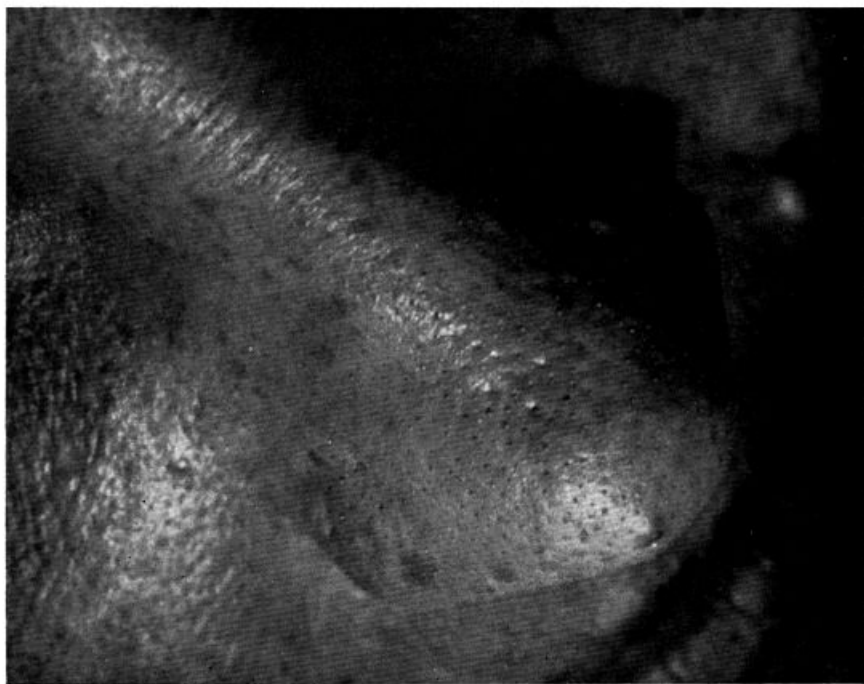


Figure 2.—Same as Figure 1 showing the architectural extrusion of the glandular contents prior to treatment.

cleansing creams. Another basic difference is that the emulsifying properties of soap result in the removal of a good portion of the surface lipid film, thereby causing so-called "skin dryness."

SUMMARY

Under filtered ultraviolet illumination, inspissated sebum in the form of minute plaques lying upon the sebaceous orifices has been observed to be commonly present in all subjects examined. These plaques are resistant to removal by soap and water but are readily removed by cleansing creams and other preparations; differences in efficacy have been observed among four commercial cleansing creams and among an arbitrary series of individual ingredients. These findings suggest the possibility that one of the fundamental virtues of cleansing creams may be their ability to facilitate removal of these sebal plaques without seriously altering the surface lipid layer.

NOTES IN REFERENCE TO FIGURES

Serious difficulties were encountered in obtaining satisfactory photographs of fluorescent inspissated sebum *in vivo* because of ultraviolet film

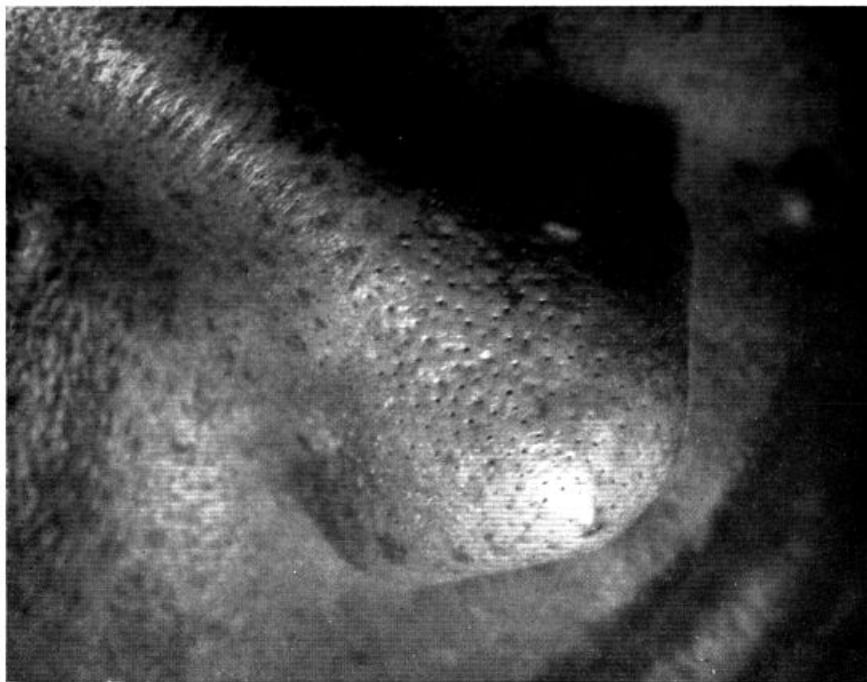


Figure 3.—Same as Figure 1 following treatment of the area with cleansing cream for sixty seconds showing the absence of glandular excretions in the surface pores.

sensitivity, et cetera. Under intense filtered ultraviolet illumination, fluorescent areas could be clearly focused upon the ground glass of the camera but curiously did not appear in the processed panchromatic negatives. However, it was discovered that when a pale yellow filter was used on the lens during exposure, the fluorescent sites were recorded in excellent detail and were greatly dependent upon the density of the particular filter used. The accompanying figures are presented as general examples of sebum fluorescence and glandular excretion. All were photographed by Lewis J. Sunny, B.P.A., using filtered ultraviolet light as the sole source of illumination.

BIBLIOGRAPHY

- (1) Rothman, Stephan, "Physiology and Biochemistry of the Skin," Chicago, The University of Chicago Press (1954), pp. 284-336.
- (2) Montagna, W., "The Structure and Function of Skin," New York, Academic Press, Inc. (1956), pp. 255-293.
- (3) Weitkamp, A. W., *J. Am. Chem. Soc.*, **67**, 447 (1945).
- (4) MacKenna, R. M. B., Wheatley, V. R., and Wormall, A., *J. Invest. Dermatol.*, **15**, 33 (1950).
- (5) Wheatley, V. R., *St. Bartholomew's Hosp. J.*, **57**, 5 (1953).
- (6) Rothman, S., and Schaaf, F., in Jadassohn, "Handb. d. Haut- u. Geschlechtskr.," Vol. 1, Berlin, J. Springer (1929), p. 161.
- (7) Peck, S. M., Rosenfeld, H., Leifer, W., and Bierman, W., *Arch. Dermatol. and Syphilol.*, **39**, 126 (1939).
- (8) Burtenshaw, J. M. L., *J. Hyg.*, **42**, 184 (1942).

RHEOLOGICAL REVIEW FOR COSMETIC CHEMISTS*

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RHEOLOGY is the science of the deformation and flow of matter. That is a rather sweeping definition, since it allows ample room for studies from mayonnaise to volcanic lava, as well as from blood serum to wet sea sand. Our purpose here, since the scope of the subject is enormous, is to choose a few aspects which might have a direct and practical bearing in the field of cosmetic chemistry. We should like to suggest a few thoughts which may be helpful in your work of continual improvement of various pastes, creams, solutions and emulsions, the bulwark of your trade.

Perhaps it would also be well to enter a standard disclaimer clause at this point. We are all familiar with the necessary custom in the chemical industry. The printed brochure describes wonderful new products and rec-

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