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Abstracts

The Annual Scientific Meetings and Seminars of the Society of Cosmetic Chemists are important venues for informing the participants about the state of the art and recent technical advances in the field of Cosmetic Science. To provide broader dissemination of that information, the Publications Committee has decided to publish abstracts of the technical presentations made at these Meetings and Seminars in the *Journal*.—The Editor.

Annual Scientific Meeting

December 7–8, 1989
The New York Hilton, New York City

James Akerson (Clairol, Inc.), Chairman, 1989

SCIENTIFIC SESSION A
ADVANCES IN SURFACE SCIENCE I

A short walk through surface chemistry: Viewpoints on cosmetics

Paul Becher, Paul Becher Associates Ltd., P.O. Box 7335, Wilmington, DE 19803

A preliminary discussion of the theoretical background of surface chemistry, with particular attention to the behavior of surface-active agents, is followed by some thoughts on how some recent developments (in, for example, lipid behavior and micellization) can be connected with practical applications (for example, skin mildness).

Micelles, solubilization, liquid crystals, liposomes, and skin structure modelling

Stig E. Friberg, Department of Chemistry, Clarkson University, Potsdam, NY 13676

Surfactants adsorb strongly to interfaces, a phenomenon of importance for emulsion and foam stability. In addition, they spontaneously form their own interfaces within one-phase parts or systems.

The result, micellar and liquid crystalline organizations, has a pronounced influence on the properties of macro-dispersed systems such as emulsions and foams as well as on many biological tissues.

As an example of the latter, the lipid organization in the stratum corneum will be reviewed.

SCIENTIFIC SESSION B
FRONTIERS OF SCIENCE LECTURE
Sponsored by Felton Worldwide, Inc.

Topobiology

G. M. Edelman, The Neurosciences Institute of the Neuroscience Research Program, 1230 York Avenue, New York, NY 10021

There is at present no adequate theory of development in the sense that there are adequate theories of evolution and genetics. The reason is that the molecular processes leading to the formation in time of animal form are just beginning to be described. The key question is: How does the one-dimensional genetic code specify a three-dimensional animal of a given species?

Recent analysis of the fundamental processes regulating development have given new insights that promise an answer to this question. A major clue rests in our understanding of the molecules that mediate the adhesion of one cell type to another. Some of these molecules are now identified, and experiments of the times and places of their expression give further clues to their regulation during development. These findings suggest that the study of place-dependent expression of such morphoregulatory molecules (a field I have called topobiology) will be particularly fruitful. This field bears on how cells move and tissue sheets fold to form embryonic patterns. In this lecture, I will review these issues,

show how topobiological interactions can alter tissue pattern and animal form, and comment upon some possible applications of these findings.

SCIENTIFIC SESSION C (Concurrent) PRODUCT EVALUATION

Clinical evaluation of cosmetic products: A critique of current concepts

Morton Pader, Ph.D., Consumer Products Development Resources, Inc., 1358 Sussex Road, Teaneck, NJ 07666

The design and interpretation of clinical trials of cosmetic products are explored. A valid assessment of the efficacy of a new product must take into account at least two major concerns: (1) the nature of the placebo or control and (2) compliance of the subject with predetermined product dosage. The first concern involves overcoming the Hawthorne effect in the clinical design. This is usually attempted by the use of a placebo, but the approach is not always sound, as demonstrated by examination of pertinent reports to be cited from the literature. Compliance with product usage is rarely accommodated in clinical trial design. A review of published studies suggests clinical trials can be usefully considered in three categories for evaluation of product efficacy. These encompass a hierarchy of designs ranging from testing of product and elements thereof in simple, well-established vehicles and evaluation systems, through field trials which bring into play the factor of compliance. Examples from the literature and practice are given to illustrate features of three types of clinical trial and the role of each in complete product evaluation. Negative aspects of some currently favored clinical designs are critiqued based on these examples.

Combined application of topographical and light reflectance methods for evaluation of skin condition

Peter L. Dorogi, Ph.D., Peter R. Hilliard, Jr., Ph.D., Alfred A. Hambidge, Jr., and June T. Hull, Clairol, Inc., Clairol Research Laboratory, 2 Blachley Road, Stamford, CT 06922

Short-term exposure of skin to cold hexane induces a clearly visible "ashy" condition, similar to that seen in severely dry skin conditions. Detailed microscopic examination of the skin surface, using scanning electron microscopy (SEM) and high-resolution profilometry, reveals the prevalence of loose scales and a relatively flat surface relief, and shows that the perceptible ashiness induced by hexane is due to both surface damage and dehydration. An investigation was conducted to see whether the response to hexane can be used as a predictive tool to test the tendency to develop dry skin symptoms.

The appearance of dryness was assessed objectively using tristimulus parameters (L,a,b) to describe reflectance properties of the skin. Measurements were obtained on 15 subjects before and after hexane exposure, during both summer and winter. Results include the finding that total reflectance (L) is more dramatically affected in winter than summer ($p < 0.001$), and suggest the possibility of using hexane-enhanced light refectance from the skin for objective assessments of the susceptibility to dryness.

Consumer-driven product development—Creating winning products by putting consumers into the development loop

Howard R. Moskowitz, Ph.D., Moskowitz/Jacobs, Inc., 14 Madison Avenue, Valhalla, NY 10595

The competitive marketplace measures success by consumer purchase and repeat rate. This presentation shows how the product developer and marketer can use consumer responses to create products that are more acceptable, less costly (in ingredient dollars), and more targeted to specific groups of consumers. The approaches use structured development of concepts to create positionings, segmentation of consumers to find ready niches of consumers interested in the product, and systematic product development and optimization to create the actual products satisfying those niches of consumers.

Applications and pitfalls of *in vitro* release and skin penetration studies

Joel L. Zatz, Ph.D., Rutgers University, P.O. Box. 789, Piscataway, NJ 08855-0789

During product development, measurements of skin penetration *in vitro* provide one means of comparing candidate formulations. The rationale for using excised human skin is that the principal skin barrier, the stratum corneum, is already dead and will therefore not suffer by removal from the live organism. Among the potential limitations of *in vitro* experiments are the loss of enzymatic activity and development of diffusional resistance within the aqueous skin layers. The seriousness of each of these problems, and strategies for dealing with them, depend largely on the chemistry of the permeant. Although excised human skin is often preferred for *in vitro* studies, a high degree of skin variability may cloud comparisons made among competing formulations. Selection of appropriate experimental controls helps to alleviate this problem. Under certain conditions, release from the vehicle may become

rate-limiting. Release experiments may then provide insight into the permeation process.

SCIENTIFIC SESSION D (Concurrent) GENERAL PAPERS

Inhibition of UVB-induced arachidonic acid release *in vitro* as a model for evaluation of anti-inflammatory ingredients

K. Marenus, Ph.D., T. Mammone, S. Jadlos, D. Maes, and W. Smith, Estee Lauder Co., Research Park, 125 Pinelawn Road, Melville, NY 11747

The release of arachidonic acid from the cell membrane is the committing step to the prostaglandin cascade. Prostaglandins have been shown to mediate inflammation *in vivo*. We have investigated UVB-induced arachidonic acid release as a model of inflammation. Prior to testing, materials were evaluated for cellular toxicity, and acceptable use levels were determined. Normal human keratinocytes were prelabeled for 24 hours with tritiated arachidonic acid. These cells were then irradiated with 0, 400, 800, and 1200 mJ/cm^2 UVB. These doses caused a graded release of arachidonic acid and therefore can be used as a model for inflammation. Several agents were found to inhibit arachidonic acid release (Table). This *in vitro* model is useful for screening prospective ingredients.

Table

Anti-inflammatory	Conc.	Average reduction (across all doses)
Ibuprofen	0.02	33%
Indomethacin	0.325	26%
Cortisone	0.05	24%
Acetyl salicylate	0.03	21%

Effects of enhancer pretreatment in skin permeation of erythromycin

M. S. Kislalioglu, Ph.D., and A. Iyer, Department of Pharmaceutics, University of Rhode Island, Kingston, RI 02881-0809

In this study, the effects of propylene glycol (PG), oleic acid, and Azone pretreatments on the skin uptake and on the flux of erythromycin from saturated pH 8.9 borate buffer (BP) and isopropyl myristate (IPM) solutions were investigated. The left dorsal back skins of hairless mice having 2.5 cm^2 areas were treated with 10 μl of the enhancer. Right dorsal back sides were used as controls. The animals were sacrificed after an hour, and the pretreated skins and control sites were removed and placed in the Franz cells. Saturated erythromycin solutions (100 μl) were then spread on the skin pieces, and diffusion of ^{14}C-labeled erythromycin was followed by liquid scintillation counting. PG treatment had no effect on the flux of erythromycin from BP and from IPM. It exerted no changes in skin concentrations. Azone pretreatment caused a more pronounced increase in erythromycin diffusion from IPM than from BP. Azone was the most potent enhancer in increasing the flux of erythromycin.

Phospholipid liposome/surfactant interactions as predictors of skin irritation

Ursula K. Charaf and Gerald L. Hart, S. C. Johnson Wax, 1525 Howe Street, Racine, WI 53403

A sensitive method is described where large unilamellar liposomes are used as a model membrane system to study and define surfactant–skin interactions. The relative tendency of surfactants or surfactant blends to form mixed micelles with liposome membrane components determines the aggressivity factor believed to be related to *in vivo* surfactant irritation responses. Single surfactants and surfactant mixtures were investigated, and their behavior toward liposome membranes was used to establish a mathematical index of surfactant aggressivity. Good correlation was established between this index and *in vivo* scores for the anionic surfactants and blends tested, as well for as some types of nonionics and mixed blends. This method has distinct advantages over traditional *in vivo* tests. It is expedient, inexpensive, sensitive, objective, and reproducible. Moreover, it does not use live animals and does not derive its components from tissues or organs.

In vitro permeation of tolmetin through irradiated and non-irradiated hairless mouse skin

Jean P. Holland, R.Ph., and E. R. Lukenbach, Ph.D., Johnson & Johnson Baby Products Co., 199 Grandview Road, Skillman, NJ 08558, and J. L. Lichtin, M.D., and A. Sakr, Ph.D., University of Cincinnati, Cincinnati, OH

Over exposure of the skin to ultraviolet radiation, sunburn, will result in redness, swelling, heat, and pain. Currently marketed sunburn treatment products are only palliative. The literature indicates that topical non-steroidal anti-inflammatory agents exhibit a potential to be a therapeutic treatment. This study explores the effect of ionization of a non-steroidal anti-inflammatory agent, tolmetin, on permeation and explores the effect of skin irradiation on *in vitro* permeation.

Five solutions ranging from 0.99 to 99.30% ionized were applied to irradiated and non-irradiated albino hairless mouse skin in Franz diffusion cells.

The irradiated membranes did not exhibit a significant increase in the amount of tolmetin permeating relative to the normal skin, nor did the tolmetin applied to irradiated skin have a greatly increased flux.

The highly ionized solutions permeated significantly less than the solutions with a lesser degree of ionization.

The release and *in vitro* permeability studies of salicylic and benzoic acid from topical formulations

A. Jain, A. Sakr, Ph.D., and J. L. Lichtin, Ph.D., University of Cincinnati, Cincinnati, OH, and Jonas C. T. Wang and S. Wisniewski, Johnson & Johnson Baby Products Co., Grandview Road, Skillman, NJ 08558

The objectives were to study the release and *in vitro* permeation profiles of salicyclic and benzoic acid from topical formulations, as a function of film thickness and vehicle. A combination of 0.5% and 1% w/w off salicyclic and benzoic acid was incorporated in cold cream U.S.P., polyethylene glycol ointment N.F., white petrolatum U.S.P., hydrophilic ointment U.S.P., alcoholic gel, and ethanol. A Spectra Mesh® fluorocarbon filter was used for the release studies, and abdominal sections of hairless mouse skin and human cadaver skin were used for permeability studies. Finite doses of each formulation were applied at three different thicknesses. The studies were conducted using Franz diffusion cells and Sorensen's phosphate buffer, pH 7.40, as the receptor medium. One hundred fifty microliters of receptor fluid was withdrawn with replacement and analyzed by HPLC. The study results suggested that depending on the thickness of the film applied, the overall delivery mechanism was formulation- and compound-dependent. It was observed that the permeation rate of drug delivery was highly dependent on the magnitude of partitioning and solubility. Vehicle influences on delivery were observed where the solubilized drug fraction was low.

SCIENTIFIC SESSION E
ADVANCES IN SURFACE SCIENCE II

The use of foams in cosmetics

Sydney Ross, Department of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12180-3590

The chief use of forms in cosmetics is to supply a ready-made detergent foam for shaving. The purpose of the foam is to soften the hair and to lubricate the razor. The foaming agent is a combination of anionic and nonionic surface-active solutes. Shaving foam is stabilized by the presence of a plastic microfilm consisting of a gelled combination of solutes and water.

Three-component systems of this chemical type have an L1 or aqueous liquid crystal phase at certain overall concentrations of the components. The surface activity of the solute mixture is responsible for creating a film of different composition from the underlying isotropic solution; this film, at appropriate overall concentrations, has the composition of the L1 phase, which is thus segregated by the foregoing mechanism, i.e., spontaneous adsorption of solute, in the form of a microlayer at the surface. Neither the L1 phase nor the aqueous isotropic solution, when separate, form stable foams, but they do so when combined. The role of industrial research is to determine the appropriate composition for these effects to occur, based on foam stability as the ultimate indicator, in contrast to the academic approach, admittedly more laborious and, for the required application, less direct, in exploring phase-diagram behavior.

Multiple-phase emulsions

Dr. G. M. Eccleston, University of Strathclyde, Glasgow, U.K.

Cosmetic and pharmaceutical emulsions, such as lotions and creams, are rarely simple oil-in-water or water-in-oil preparations. They are more likely to be complex colloidal systems containing several surfactants, amphiphiles, and other additives, and to be composed of additional phases (e.g., lamellar liquid crystalline or gel) to oil and water. These additional phases form in aqueous emulsions when the emulsifiers, in excess of those required to stabilize oil droplets, interact with continuous-phase water. Thus the phase behavior of the emulsifiers and their mixtures in water can provide valuable information about microstructures of emulsions prepared with them. In this paper, it will be shown how the behavior of many dermatological emulsions during manufacture, storage, and use (i.e., after application to the skin) can be related to their component phases.

Polymer/surfactant interaction

E. D. Goddard, Ph.D., Union Carbide Corporation, Specialty Chemicals Division, Tarrytown, NY 10591

Interaction between water-soluble polymers and surfactants, which are common ingredients of cosmetic formulations, is a widespread phenomenon. While attraction is strongest when the two ingredients bear an opposite electrical charge, this condition is not a prerequisite for interaction. Guide-

lines for predicting the type and extent of interaction that can occur will be presented together with a description of the effect of structural variation of the two components. The different types of physical forces involved in forming the "complexes" will be outlined, as well as several ways of investigating their formation. The types of property change that can be expected of both components will be discussed; these include changes in adsorptive and viscosifying characteristics. Lipoproteins, the traditional surfactant/polymer complexes of natural origin, will not be included in this reivew, which will be restricted to synthetic polymer/surfactant systems.

Stabilization of emulsions by adsorbed macromolecules

Robert Y. Lochhead, Ph.D., BF Goodrich Company, P.O. Box 122, Avon Lake, OH 44012

Stabilization of dispersions and emulsions by adsorbed polymers is not new. It has been practiced since the time of the ancient Egyptians and Chinese. On the other hand, basic understanding of the fundamental science that underlies this phenomena is relatively new, and this area is currently a focus of much scientific research.

This paper will consider the adsorption and conformation of macromolecules at solid/liquid and liquid/liquid interfaces; the mechanism by which "steric stabilization" operates; the benefits of steric stabilization and its limitations; how electrosteric stabilization can be used to provide triggered release of actives from a preparation to a substrate; and finally, formulation guidelines for the preparation of sterically-stabilized emulsions.

SCIENTIFIC SESSION F (Concurrent) COLOR COSMETICS

Powder product technology innovation through novel raw material selection

Alan Farer, Cosmair, Inc., 285 Terminal Avenue, Clark, NJ 07066

In the past, innovation was a word typically used to describe cosmetic treatment items, moisturizers, wrinkle creams, and high-SPF waterproof sunscreens. Today, however, innovation has become essential to the power product development chemist as well.

Aesthetically, today's powder products feel dramatically different than they did just a few years ago. We have the capability of making anhydrous makeups and blushers feel like powders, and powder makeups and blushers feel like creams. Typical raw materials have become innovative through treatments with silicones, lecithin, amino acids, metallic soap, tri-isostearyl trimerate, and others. Also, novel manufacturing techniques have provided us with the microfine spherical polyethylenes, nylons, silicas, titanium dioxide, speciality iron oxides, and micro-bubbles.

Functionally, through proper utilization of these novel raw materials, today's powder development chemist is creating products that not only look good in the display case but have wonderful application and feel properties while markedly improving the user's physical appearance.

Through discussion of the varied raw materials, you will come to understand the innovative capabilities of today's powder development chemist.

The technology of cosmetic pencils

John Cunningham, COSMOLAB Inc., 1100 Garrett Road, Lewisburg, TN 37091

Extruded pencils present their own particular set of formulation challenges.

Current technology dictates that extruded bases require a high solid/oil ratio to form stable sticks, a requirement that runs counter to the consumer desire for the product to have the smooth color laydown of conventional molded leads.

Unfortunately, many of the raw materials that best achieve these attributes tend to form polymorphic crystalline structures. In practice, this can lead to long-term product instability that in turn manifests itself in such ways as lead-hardening and surface-blooming. The importance, therefore, of raw material selection cannot be overemphasized when embarking upon such a development project, and the more conventional quality control test methods are best supplemented by additional and more sophisticated rheological studies.

Visually different cosmetics

Ernest Curtis, Kolmar Labs, Inc., King Street, Port Jervis, NY 12771

Color has always been one of the most important marketing tools for cosmetic products. During the past few years visually different products have attracted must consumer interest. At first this was done with multicolored items such as two or more shades in a single package. Colors have now been expanded to include multicolor and multishaped products and are being used as a "signal" for actives in core, spiral, or bead forms. Finally, colors can be used to signal the consumer to two distinct products in one or to change color when products are used to show that these products are working.

The advantages and limitations in manufacturing and formulation of these visually different colored products will be discussed.

In vivo testing of nail polish and the general effects of shade families on their performance
Greg Wanamaker, Chesebrough Ponds, Inc., 40 Merritt Blvd, Trumbull, CT 06611

The wear characteristics of nail polish formulas are a major concern to nail polish manufacturers and marketers. Analytical test methods, which include the use of viscometers, glossometers, and pendulum hardness testers, are necessary tools for quality control but are not totally indicative of acceptable performance to the consumer. *In vivo* testing, on the other hand, is the final step in evaluating wear characteristics of polish formulations and is increasingly important in supporting advertising and marketing claims.

The use of descriptive analysis panels with computer-processed rating forms compensates for panelist biovariability and improves report time. The numerical results of this testing can easily be plotted to show how individual shades will perform within their product line and against competitors. Generalities about the overall characteristics can be inferred when analyzing pigment types and quantities in one-coat and two-coat systems.

From laboratory to manufacturing—The potential benefits of monitoring the quality of lipstick pigment dispersions
Thomas W. Kahle, Noxell Corporation, 11050 York Road, Hunt Valley, MD 21030

Product development chemists are periodically faced with the task of shading and approving first-production batches of their newly developed formulae. On a day-to-day basis, Q.C. faces similar challenges with ongoing production.

This discussion begins with a brief description of a typical lipstick production shading problem, its likely cause, and often overlooked solution.

The conclusion provides the potential benefits of cost reductions, higher efficiency, and more uniform master to batch-to-batch integrity.

SCIENTIFIC SESSION G (Concurrent) GENERAL PAPERS

Alkoxylated methyl glucoside quaternary: Conditioning agent for hair and skin
Straut B. Polovsky, Ph.D., and Joseph P. Pavlichko, Amerchol, P.O. Box 351, Edison, NJ 08817

Quaternaries affect important properties associated with hair conditioning such as improved wet and dry combing, feel, luster, and antistatic activity. A new class of quaternary ammonium compounds will be introduced based on alkoxylated methyl glucoside chemistry. Alkoxylated methyl glucoside quaternary (AMGQ) is the newest addition to the highly functional family of methyl glucoside derivatives that are noted for their extreme mildness to skin and hair.

AMGQ is prepared by functionalizing hydroxyl groups via the addition of a lipophilic quaternary center, thus forming a cationic molecule that is substantive to hair and skin. In addition, the resulting quaternary maintains the extreme mildness of the glucoside family, i.e., low irritation potential on skin and in eyes. It has a significant effect on physical properties such as surface tension. The hydrophilic moiety of AMGQ renders it a powerful humectant.

This material is versatile in its use and is compatible with many modern formulation ideas such as skin-conditioning creams and lotions, aerosol conditioning hair sprays, and styling mousses. It is useful in liquid soaps and conditioning sprays with sunscreens. This work will be presented together with data demonstrating its activity.

Quantitative evaluation of hair set parameters
Franz Frosch and Friedrich G. M. Vogel, BASF AG, 6700 Ludwigshafen, West Germany

Set and hold of polymer-treated hair can be described by several parameters: elasticity, stiffness, humidity resistance, torsion resistance, etc. Only a few models such as the "curl retention" method, have found general acceptance and are used as screening tools to evaluate the performance of setting products on hair before a salon test is made.

A new method is introduced which stimulates the effects of various setting products by stressing polymer-treated swatches with work loads. Varying the load or the frequency of stress, different information about the polymer/hair fiber interaction is obtained. In addition, further parameters, such as relative humidity, may be varied.

The model can be utilized with simple laboratory equipment or can be extended to study the mechanical properties of polymer-treated fibers in detail. The method allows the comparison of polymers alone as well as of complete formulations of setting products and correlates well with salon parameters. This method presents a valuable tool to screen different raw materials and formulations and can aid in the preselection of hair care polymers. Details and results of the novel method are discussed.

Enhancement of DNA repair of UV damage in mouse and human skin by liposomes containing a DNA repair enzyme

Daniel B. Yarosh, Applied Genetics, Inc., 205 Buffalo Avenue, Freeport, N.Y. 11520

Sunlight and ultraviolet light (UV) in particular have many deleterious effects on skin, including the induction of skin cancer. The DNA of epidermal cells is the target for an important part of this damage. After UV exposure little or nothing can be done at present to reverse the long-term effects.

A new approach has been developed to repair DNA *after* sun exposure. A highly purified DNA repair enzyme, which initiates removal of specific DNA lesions produced by UV, was encapsulated in liposomes and delivered to UV-irradiated human epidermal keratinocytes in culture and to the skin of UV-irradiated hairless mice by topical application. In treated cells and animals, removal of damage was faster, DNA repair was enhanced, and the survival of cells after exposure was significantly increased compared to untreated or sham-treated controls. These results suggest that delivery of DNA repair enzymes to human skin may become a practical method to prevent sunlight damage even after UV exposure.

New hydrogels—Basic technology and application

Steve Greenberg, Ph.D., Lipo Chemicals, Inc., 207 19th Avenue, Paterson, NJ 07504

Synthetic hydrogels have been used in soft contact lenses and other related biomedical applications as well as in cosmetic and personal care products. In this paper we introduce a new family of patented synthetic hydrogels that are multi-block copolymers derived from poly(acrylonitrile). These new hydrogels utilize strong physical interactions in maintaining their three-dimensional integrity rather than the covalent crosslinking on which other synthetic hydrogels depend. These new hydrogels are close analogues of natural hydrogels such as those found in the cornea and cartilage. They possess superior physical and mechanical properties over other synthetic hydrogels.

This paper focuses on the basic technology of this new type of hydrogel such as structure, pH, viscosity, and concentration relationships. It also discusses applications of these new hydrogels to cosmetic formulations, including their use as primary emulsifiers in water-in-oil emulsions, as stabilizers for multi-phase emulsions, and as a source of unique and desirable tactile properties in gels.