

# **Harry's Cosmeticology**

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# Harry's Cosmeticology

Seventh edition

Edited by

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## 7<sup>th</sup> Edition

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# Contents

PART ONE: THE SKIN AND SKIN PRODUCTS	1
<b>1 The Skin</b>	<b>3</b>
Introduction	3
Epidermis and keratinizing system	5
Pigmentary system	7
Langerhans cells	9
Dermis	10
Nerves and sense organs	11
Blood vessels	12
Eccrine sweat glands	13
Hair follicles	14
Sebaceous glands	15
Apocrine glands	16
Common disorders of the skin	16
<b>2 Irritation and Sensitization of the Skin</b>	<b>27</b>
Introduction	27
Irritants and inflammation	28
Hypersensitivity and allergy	33
Tests to predict irritation or sensitization	38
<b>3 Nutrition and Hormonal Control of the Skin</b>	<b>42</b>
Nutrition of the skin	42
Skin conditions related to nutritional deficiency	43
Percutaneous absorption	45
Hormones	45
<b>4 Skin Creams</b>	<b>50</b>
Introduction	50
Classification of skin creams	51
Cleansing creams	53
Night and massage creams	60
Moisturizing, vanishing and foundation creams	62
Pigmented foundation creams	67
Hand creams and hand-and-body creams	69
All-purpose creams	70
<b>5 Astringents and Skin Tonics</b>	<b>74</b>
Introduction	74

Types of astringent	74
Astringent products	75
<b>6 Protective Creams and Hand Cleansers</b>	<b>82</b>
Introduction	82
Barrier materials—protective creams and gels	83
Hand cleansers	88
<b>7 Bath Preparations</b>	<b>92</b>
Foam baths	92
Introduction	92
Formulation of foam baths	93
Types of product	98
Product assessment	100
Bath salts	101
Ingredients and formulation	101
Bath oils	103
Introduction	103
Floating or spreading oils	104
Dispersible or blooming oils	106
Soluble oils	107
Foaming oils	107
After-bath products	108
Body or dusting powders	108
After-bath emollients	109
<b>8 Skin Products for Babies</b>	<b>111</b>
Introduction	111
Skin problems in babies	111
Functional requirements of baby products	112
Safety of baby products	113
Example formulations	114
Cleansing of nappies (diapers)	117
<b>9 Skin Products for Young People</b>	<b>119</b>
Introduction	119
Adolescent skin problems	119
Products for oily skins	120
Specific treatments for acne	121
<b>10 Antiperspirants and Deodorants</b>	<b>124</b>
Introduction	124
Perspiration and its control	124
Antiperspirant ingredients	127
Evaluation of antiperspirants	130
Mechanism of deodorants and deodorant ingredients	132
Assessment of deodorants	133

<i>Contents</i>	vii
Product formulation—antiperspirants	134
Product formulation—deodorants	139
<b>11 Depilatories</b>	142
Introduction	142
Epilation	142
Electrolysis	144
Chemical depilation	144
Facial depilatories for black skin	150
The 'ideal' depilatory	151
Evaluation of depilatory efficacy	152
<b>12 Shaving Preparations</b>	156
Wet shaving preparations	156
Introduction	156
Beard softening cream	157
Lather shaving cream	159
Lather shaving stick	161
Aerosol shaving foams	161
Brushless or non-lathering cream	171
Brushless shaving stick	173
Novel compositions for wet shaving	174
Dry shaving preparations	175
Introduction	175
Pre-electric shave lotion	176
Collapsible foam pre-electric shave lotion	178
Pre-electric shave gel stick	178
Pre-electric shave talc stick	178
Pre-electric shave powder	179
After-shave preparations	180
After-shave lotion	181
Quick-break foam after-shave	184
Crackling foam aerosol after-shave lotion	185
After-shave gel	185
After-shave cream and balm	186
After-shave powder	187
<b>13 Foot Preparations</b>	190
Introduction	190
Influence of footwear	190
Foot malodours	191
Foot ailments	191
Foot infections	192
Foot care and hygiene	193
Bathing the feet	193
Foot powders	196
Foot sprays	197
Foot creams	198
Corn and callus preparations	200
Chilblain preparations	201

Athlete's foot preparations	202
Other developments	204
<b>14 Insect Repellents</b>	206
Introduction	206
Repellent materials	206
Formulation	213
<b>15 Sunscreen, Suntan and Anti-sunburn Preparations</b>	222
Sunlight and the human body	222
Introduction	222
Tanning	222
Beneficial effects of sunlight	223
Adverse effects of sunlight	223
Solar radiation and its effect on skin	225
Protective mechanism of the skin	229
Sunscreens and suntan preparations	231
Introduction	231
Sunscreen agents	231
Evaluation of sunscreen preparations	242
Formulation of sunscreens	251
Palliative preparations	256
Artificial suntan preparations	258
<b>16 Skin Lighteners or Bleaches</b>	264
Colour of the skin	264
Chemistry of melanin	265
Mechanism of depigmentation	265
Skin lightening agents and formulations	266
<b>17 Face Packs and Masks</b>	276
Introduction	276
Wax-based systems	276
Rubber-based systems	277
Vinyl-based systems	277
Hydrocolloid-based systems	278
Earth-based systems (argillaceous masks)	280
Anti-wrinkle preparations	282
<b>18 Face Powders and Make-up</b>	285
Face powder	285
Function and properties	285
Covering power	285
Absorbency	289
Slip	292
Adhesion	293
Bloom	294
Colour	295



<i>Contents</i>	ix
Perfume	296
Formulation	297
Manufacture	299
Compact powder	301
Cake make-up	304
Make-up cream	307
Liquid powder	307
Liquid make-up	310
Stick make-up	311
<b>19 Coloured Make-up Preparations</b>	314
Lipstick	314
Introduction	314
Ingredients of lipsticks	314
Example formulations	323
Manufacture of lipsticks	327
Transparent lipsticks	330
Lip salves	330
Liquid lipsticks	332
Rouge	333
Introduction	333
Dry rouge (compact rouge)	334
Wax-based rouge	336
Cream rouge	336
Liquid rouge	340
Eye make-up	341
Introduction	341
Mascara (eyelash cosmetic)	341
Eyeshadow	347
Eyeliner	351
Eyebrow pencils	352
<b>20 The Application of Cosmetics</b>	355
Introduction	355
Care and cleansing of the skin	355
Cosmetic application	357
<b>PART TWO: THE NAILS AND NAIL PRODUCTS</b>	361
<b>21 The Nails</b>	363
Biology of the nails	363
Pathology of the nails	365
<b>22 Manicure Preparations</b>	369
Cuticle remover	369
Nail bleach	371

Nail cream	372
Nail strengthener	372
Nail white	373
Nail polish	374
Nail lacquer (nail varnish)	375
Introduction	375
Ingredients of nail lacquer	376
Formulation	383
Manufacture of nail lacquer	385
Base coats and top coats	385
Enamel remover	386
Nail drier	389
Plastic fingernails and elongators	389
Nail mending compositions	391
<b>PART THREE: THE HAIR AND HAIR PRODUCTS</b>	<b>395</b>
<b>23 The Hair</b>	<b>396</b>
Introduction	396
The hair follicle	396
Hormonal influences	401
Nutritional influences	402
Chemistry of hair	403
Hair colour	413
Hair disorders	416
Dandruff	419
<b>24 Shampoos</b>	<b>427</b>
Introduction	427
Detergency	428
Evaluation of detergents as shampoo bases	429
Raw materials for shampoos	431
Principal and auxiliary surfactants	432
Additives	443
Formulation of shampoos	448
Clear liquid shampoos	449
Liquid cream or lotion shampoos	450
Solid cream and gel shampoos	451
Oil shampoos	453
Powder shampoos	453
Aerosol shampoos	454
Dry shampoos	454
Conditioning shampoos	455
Baby shampoos	457
Anti-dandruff and medicated shampoos	458
Acid-balanced shampoos	459
Safety of shampoos	460

<i>Contents</i>	xi
<b>25 Hair Setting Lotions, Sprays and Dressings</b>	470
Use and purpose of hair dressings	470
Women's hair dressings	470
Setting lotions	470
Heated curlers and blow drying	473
Hair sprays	474
Men's hair dressings	483
Formulation	484
Brilliantines	484
Non-oily fixatives	489
Aerosols	490
Emulsions	491
Gels	494
<b>26 Hair Tonics and Conditioners</b>	498
Introduction	498
Formulation of medicated hair tonics	498
Conditioners	506
Evaluation of conditioning	512
Hair thickeners	512
Rinses	513
<b>27 Hair Colorants</b>	521
Introduction	521
Hair colouring systems	521
Characteristics of an ideal hair colorant	522
The process of hair colouring	524
Temporary hair dyes	526
Dyestuffs	526
Types of commercial temporary product and their formulation	528
Semi-permanent colorants	528
Dyestuffs	528
Commercial semi-permanent products and their formulation	532
Permanent hair dyes	533
Bases	534
Couplers or modifiers	535
Formation of colours in the hair	535
Toxicity and dangers of para dyes	538
Formulation of permanent hair dyes	540
Other dyes for hair	544
Aromatic polyhydroxy compounds	544
Vegetable hair dyes	545
Metallic hair dyes	546
Hair dye removers	547
Bleaching and lightening	547
<b>28 Permanent Waving and Hair Strengtheners</b>	555
Introduction	555
Chemistry of hair waving	556
Evaluation of permanent waving	563

Hot waving processes	567
Cold waving processes	569
Tepid 'warm air' wave	574
Roller and pin permanent waves	574
Instant permanent waves	575
Perfuming of thioglycollate lotions	575
Toxicity	575
Hair strengthening preparations	575
<b>29 Hair Straighteners</b>	<b>581</b>
Introduction	581
Hot comb method	581
Caustic preparations	581
Chemical hair reducing agents	583
<b>PART FOUR: THE TEETH AND DENTAL PRODUCTS</b>	<b>587</b>
<b>30 The Tooth and Oral Health</b>	<b>588</b>
Introduction	588
The tooth and its surroundings	588
Structure of the tooth	588
Saliva	590
Acquired integuments of the tooth	590
Major problems of oral health	593
Magnitude of the problem	593
Dental caries	594
Periodontal disease	599
Use of prophylactic toothpastes	600
Active ingredients	600
<b>31 Dentifrices</b>	<b>608</b>
Basic requirements of a dentifrice	608
Toothpastes	609
Basic structure	609
Ingredients	609
Formulation of toothpastes	615
Manufacture of toothpastes	616
Toothpowders	617
Manufacture of toothpowders	618
Solid dentifrice	618
Performance tests	618
Abrasive action	619
Lustre (gloss or polish)	620
The toothbrush and toothbrushing	621
Denture cleansers	622
<b>32 Mouthwashes</b>	<b>626</b>
Introduction	626
Choice of antibacterial agent	627

<i>Contents</i>	xiii
Flavouring of mouthwashes	628
Aerosol mouth fresheners	629
<b>PART FIVE: PRODUCT INGREDIENTS AND MANUFACTURE</b>	<b>631</b>
<b>33 Surface-active Agents</b>	<b>632</b>
Introduction	632
Classification of surfactants	632
Properties of surface-active agents	633
Selection and use of surface-active agents	637
Biological properties of surface-active agents	639
<b>34 Humectants</b>	<b>641</b>
Introduction	641
Drying out	641
Types of humectant	642
Hygroscopicity	643
Stability of emulsions	650
Safety	651
Skin moisturizing	651
<b>35 Antiseptics</b>	<b>653</b>
Introduction	653
Microbial flora of the body	654
Effects of antibacterial agents on body flora	655
Antibacterial soap bars and other skin degerming preparations	657
Antimicrobial agents commonly used in antiseptic products	659
<b>36 Preservatives</b>	<b>675</b>
Introduction	675
Microbial metabolism	676
Clinical significance of contamination	678
Origins of contamination	681
Microbial growth in products	683
Preservative requirements	686
Factors influencing the effectiveness of preservatives	686
Selection of a preservative	696
Safety aspects	699
Tests for preservative effectiveness	701
Current UK regulations	703
<b>37 Antioxidants</b>	<b>707</b>
Introduction	707
General autoxidative theory	707
Antioxidants	714
Measurement of oxidation and the assessment of antioxidant efficiency	717
Choice of antioxidant	721

Phenolic antioxidants	722
Non-phenolic antioxidants	724
Photo-deterioration	725
<b>38 Emulsions</b>	729
Introduction	729
Basic principles	729
Stabilization of cosmetic emulsions	733
Other factors affecting the stability of emulsions	742
Practical aspects of emulsifier choice	745
Assessment of emulsion stability	749
Characteristics of emulsions	750
Determination of emulsion type	754
Quality control and emulsion analysis	754
<b>39 The Manufacture of Cosmetics</b>	757
Introduction	757
Mixing—and the manufacture of bulk cosmetic products	759
Solid–solid mixing	760
Manufacture of pigmented powder products	762
Mixing processes involving fluids	767
General principles of fluid mixing	767
Mixing equipment for fluids	769
Solid–liquid mixing	788
Suspension of solids in agitated tanks	792
Liquid–liquid mixing	793
Miscible liquids	793
Immiscible liquids	793
<b>40 Aerosols</b>	800
Introduction	800
The aerosol	800
Containers	801
Valves	804
Propellants	808
Filling of aerosols	817
Types of dispensed aerosol product	821
Two-phase systems	821
Three-phase systems	825
Personal care products with alternative propellants	831
Corrosion in aerosol containers	833
Alternative systems	839
Propellant-free dispensing pumps	843
<b>41 Packaging</b>	849
Introduction	849
Principles of packaging	849
Marketing and packaging	849

<i>Contents</i>	xv
Technology and components	850
Plastics	850
Metals	852
Laminates	853
Glass	854
Paper and board	855
Printing and decorations	858
Package development and design	858
Technical aspects of design	859
Closures	860
Package testing and compatibility	861
<b>42 The Use of Water in the Cosmetics Industry</b>	864
Properties and cosmetic uses of water	864
Composition of mains water	864
Water purity requirements for cosmetics	865
Further purification of mains water	866
Distribution systems	872
Good housekeeping	876
<b>43 Cleanliness, Hygiene and Microbiological Control in Manufacture</b>	877
Introduction	877
Sources of contamination	878
Cleaning and disinfection	880
Cleaning staff	880
Equipment cleaning	881
Equipment disinfection	884
Parameters of cleaning, disinfection and rinsing	888
Control of contamination	891
Hazards from personnel	891
Washrooms and toilets	892
Raw materials	893
Storage areas	894
Product packaging	894
Microbiological standards	895
Conclusion	896
<i>Appendix</i> Proprietary Materials Cited in this Book	899
<i>Index</i>	915





PART ONE

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## **The Skin and Skin Products**



## The Skin

### Introduction

The skin<sup>1-3</sup> is not simply a protective wrap for the body; it is a busy frontier which mediates between the organism and the environment. It not only controls the loss of valuable fluid, prevents the penetration of noxious foreign materials and radiation and cushions against mechanical shock, but also regulates heat loss and transduces incoming stimuli. Moreover, by its colour, texture and odour it transmits sexual and social signals which may possibly be physiologically enhanceable by cosmetic science but certainly are culturally enhanceable by cosmetic art. For cosmeticians, whether they are concerned with the improvement of the skin by pharmacology or the prevention of damage as a result of artifice, an understanding of skin structure and function is essential.

The total area of the skin ranges from about 2500 cm<sup>2</sup> at birth to 18 000 cm<sup>2</sup> in the adult, when it weighs about 4.8 kg in men and 3.2 kg in women.

There are two main kinds of human skin: hairy and glabrous. Over most of the body the skin possesses hair follicles with their associated sebaceous glands. However, the amount of hair varies greatly; at the extreme, the scalp, with its large hair follicles, may be contrasted with the female face, which has large sebaceous glands associated with very small follicles which produce fine, short vellus hairs. The skin of the palms and soles lacks hair follicles and sebaceous glands, and is grooved on its surface by continuously alternating ridges and sulci which form patterns of whorls, loops or arches, unique to each individual, known as dermatoglyphics (Figure 1.1). Glabrous skin is also characterized by its thick epidermis and by the presence of encapsulated sense organs within the dermis.

The barriers to permeability are situated in the several layers of closely packed cells which form the overlying epidermis; mechanical protection is provided by the thicker underlying dermis which is composed mainly of connective tissue, that is, material secreted by cells and lying outside of them. Isolated epidermis is as impermeable as whole skin, whereas once the epidermis is removed the dermis is completely permeable. If the epidermal layers are progressively stripped by adhesive tape, the permeability of the skin increases, and there is little doubt that the bonded, interlocked, horny cells of the stratum corneum constitute the barrier. It is unlikely that emulsified fat on the skin surface greatly affects permeability, or that the sweat glands and hair follicles are more permeable than the surface epithelium, though material may possibly reach the sebaceous glands by the follicular route.

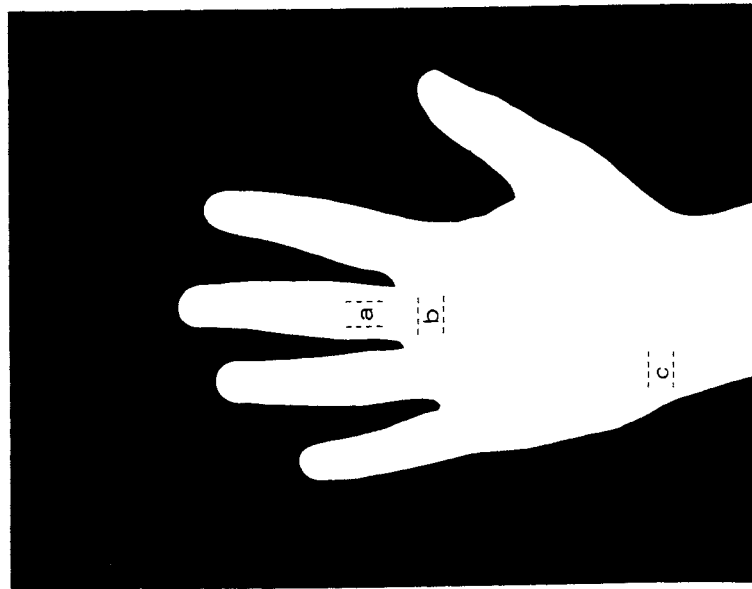
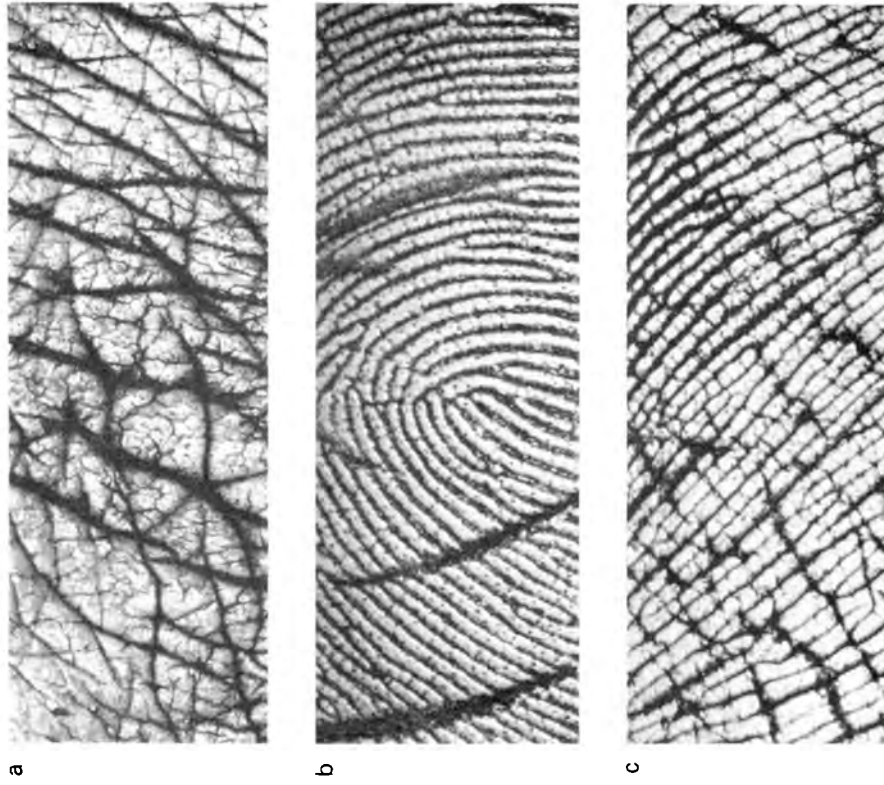


Figure 1.1 Skin patterns of the human hand (magnification  $\times 4.5$ ) a Dorsal b Palmar c Palmar

### Epidermis and the Keratinizing System

The epidermis consists of a number of layers. The stratification is the result of changes in the *keratinocytes* as they move outwards from the basal layer, in which they are continuously formed by mitosis, to the skin surface where they are lost.<sup>4-7</sup> Three other cell types are present: *melanocytes* or pigment cells, *Langerhans cells*, which are colourless and dendritic in form, and *Merkel cells*, which are concerned with sensation (see below).

#### *Dermo–Epidermal Junction*

The dermo–epidermal junction is undulating in section; so-called rete pegs or epidermal ridges project from the epidermis into the dermis. At the junction is a basement membrane, which under the electron microscope is seen as a convoluted plasma membrane studded with *semi-* or *junctional desmosomes*, separated from the underlying electron-dense *basal lamina* by a clear *lamina lucida*. The basal lamina is anchored in the dermis below by fibrils and bundles of fine filaments.<sup>7,8</sup>

#### *Stratum Basale*

The *stratum basale* or *stratum germinativum* is a continuous layer which gives rise to all the keratinocytes. It is usually described as one cell thick,<sup>7</sup> but in thick normal or pathological epidermis it appears that mitosis may not be confined to cells in contact with the basement membrane.<sup>9-11</sup> Do cells destined for differentiation arise as daughters of progenitors permanently committed to cell division? One view is that both daughters equally retain the capacity to divide for a time, but that for each division a basal cell moves into the stratum spinosum, either at random<sup>12,13</sup> or by precedence of age.<sup>14</sup> However, Potten<sup>15</sup> supports the traditional concept of permanent stem-cells, though he concedes that daughters may remain capable of a few ‘amplification’ divisions before differentiating.

Between one division and the next the cell undergoes a cycle.<sup>16-19</sup> Immediately following mitosis (M) is a growth phase ( $G_1$ ), which is succeeded by a period of active nuclear DNA synthesis (S) and a short premitotic growth phase ( $G_2$ ). Each period has a *transit time*; for the complete cycle the term ‘cell cycle time’ should be used. The expression ‘*turnover time*’, and its synonyms ‘*regeneration time*’, or ‘*replacement time*’, refer to the time for complete replacement of a cell population. Although frequently stated to be equivalent to the cell cycle time, this would only be true if all the cells were continually cycling. In fact, it is likely that there is a substantial compartment ( $G_0$ ) of non-cycling cells. It is, moreover, important to distinguish the turnover time of the stratum corneum from that of the viable epidermis.

The average duration of the cell cycle has been variously estimated for normal human epidermis as 163 hours,<sup>19</sup> 308 hours,<sup>20</sup> 457 hours<sup>21</sup> and 213 hours,<sup>22</sup> and for psoriatic epidermis as 37 hours.<sup>23</sup> However, these measurements have assumed that in normal epidermis all cells cycle continuously. An alternative explanation is that psoriatic epidermis differs from normal not because of a shorter cell cycle, but because it has a much higher proportion of cycling cells.

The replacement time for the whole viable epidermis is probably about 42 days<sup>24</sup> and for the stratum corneum about 14 days,<sup>25,26</sup> and it is generally agreed that the times are considerably less in psoriatic skin.<sup>27-29</sup>

Cells of the stratum basale have large nuclei; under the electron microscope their cytoplasm reveals many ribosomes, mitochondria and, sometimes, smooth membranes. In particular, they contain numerous fine *tonofilaments*, about 5 nm in diameter, which occur mainly in loose bundles, the *tonofibrils*.

#### *Stratum Spinosum*

The *stratum spinosum* or prickle cell layer is so called because the cells are given a spiny appearance by the numerous *desmosomes* or attachment plaques at their surfaces. These were once believed to be intercellular bridges through which the tonofibrils maintained the tonus of the epidermis. Ultrastructural studies reveal that they are laminated structures. In the upper region of the stratum spinosum, *membrane-coating granules*,<sup>30,31</sup> also known as lamellated or Odland bodies,<sup>32</sup> make their appearance. These are ovoid bodies about 100–500 nm long. In the stratum intermedium they ultimately migrate towards the periphery of the cell and appear to increase in numbers in the intercellular spaces. Their function is unknown, though they appear to contain mucopolysaccharides and it has been suggested that they may constitute the intercellular cement.<sup>31</sup>

#### *Stratum Granulosum*

The stratum spinosum is succeeded by the *stratum intermedium*, or *stratum granulosum*, which contains basophil granules of a material called *keratohyalin*.<sup>33</sup>

#### *Stratum Lucidum*

The *stratum lucidum*, unstainable by the usual histological methods, can be recognized only in palmar and plantar skin.

#### *Stratum Corneum*

In the *stratum corneum*<sup>6,7,34,35</sup> the keratinocytes have lost their nuclei and virtually all of their cytoplasmic organelles and contents, including the keratohyalin granules. The cells are flattened and completely filled with keratin, in the form of bundles of filaments embedded in an opaque interfilamentous material. At the transition between the stratum intermedium and stratum corneum, transition cells or T-cells<sup>7,36</sup> are recognizable. The cornified cells in their epidermis, though not those of glabrous skin, can be shown to be arranged in regular vertical stacks, which must reflect the underlying dynamic organization.<sup>37-42</sup> Most authors now believe that both the filamentous structures of the lower epidermal layers and the keratohyalin of the stratum intermedium contribute to the formation of keratin.<sup>43,44</sup> Some, however, have held that the fibrils contribute nothing;<sup>45-48</sup> others have questioned the contribution of keratohyalin.<sup>49</sup> The most attractive, if unproven, hypothesis is that the fibrillar material, with helically arranged peptide chains, is transformed in the stratum intermedium by a sulphur-rich matrix which makes possible cystine links.<sup>7</sup> Various attempts to characterize chemically pure 'pre-keratin' have proposed units with molecular weights of 640 000,<sup>50,51</sup> 100 000–200 000<sup>52</sup> or 50 000.<sup>53</sup>

Horny cells are continuously shed from the skin surface. If skin sites are protected by cups for long periods, exfoliated material is trapped, but the thickness of the coherent stratum corneum remains unchanged.<sup>54,55</sup> It seems, therefore, that the horny layer desquamates at a final level which is not much influenced by external forces.

### Pigmentary System

Although skin owes some of its colour<sup>56</sup> to red haemoglobin in the blood vessels and yellow carotenoids in the hypodermal fat, the major determinant is a dark pigment, *melanin*, which is the product of special cells known as *melanocytes*. The skin colour of human subjects can be measured by reflectance spectrophotometry.<sup>57</sup>

Melanocytes are derived from the neural crest in the embryo<sup>58,59</sup> and migrate to many tissues of the body, including the basal layers of the epidermis and the hair bulb. They differ from other cells of the stratum basale by the possession of dendritic (that is, finger-like) processes (Figure 1.2), by which they transfer

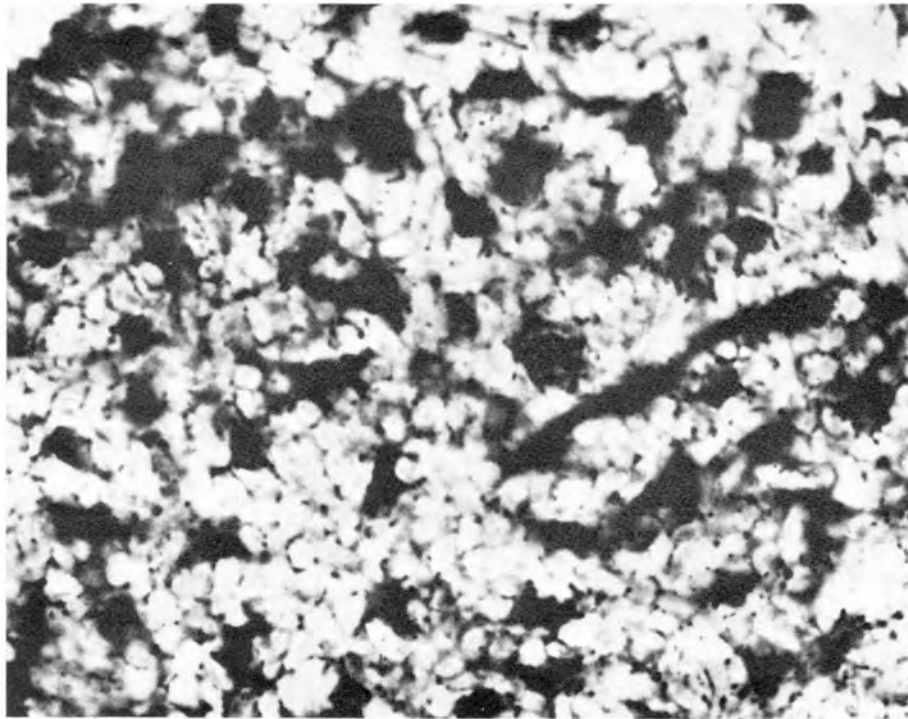


Figure 1.2 Melanocytes on underside of epidermis (magnification  $\times 500$ ): finger-like processes extend from the centres of the melanocytes

pigment to a group of keratinocytes, the whole forming an 'epidermal melanin unit'.<sup>60</sup> They have no desmosomes.

The characteristic feature of melanocytes is a special cytoplasmic organelle known as a *melanosome* (Figure 1.3) on which the melanin is formed by the action of the enzyme tyrosinase. The melanosomes arise as spherical, membrane-bounded vesicles in the zone of the Golgi apparatus. Filaments are at first



Figure 1.3 Melanosomes in various stages of melanization (magnification  $\times 29\ 000$ ): incompletely melanized granules have a striped appearance



visible in them, but the build-up of melanin ultimately results in a dense structure.<sup>61</sup>

Melanins are quinoid polymers of two kinds. *Phaeomelanins*, which are yellow or red in colour, differ from the brown or black *eumelanins* in being soluble in dilute alkali. Both are formed by the same initial steps which involve oxidation of tyrosine to 3,4-dihydroxyphenylalanine (dopa) and its dehydrogenation to dopa quinone.<sup>62</sup> The formation of eumelanins then involves several further steps to produce indole-5,6-quinone, which polymerizes and becomes linked to protein. It is now believed that eumelanin is not a homopolymer composed solely of indole-5,6-quinone units, but a poikilopolymer which includes several intermediates. Phaeomelanins are formed by a different route. The dopa quinone interacts with cysteine to form 5-S- and 2-S-cysteinyl-dopa, and these isomers are further oxidized to a series of intermediates which then polymerize.<sup>63,64</sup>

Skin colour has a *constitutive*—that is, genetic—component and a *facultative*—that is, environmental—component. Thus various degrees of pigmentation occur in different ethnic groups; the differences are in the amount of melanin produced, not in the numbers of melanocytes present. Pigmentation can be enhanced by exposure to sun, or by endocrine factors, for example in pregnancy. Melanogenesis is influenced by certain polypeptide hormones of the pituitary<sup>65–67</sup> and to some extent by steroid hormones. From hog pituitary, two melanocyte-stimulating hormones  $\alpha$ -MSH and  $\beta$ -MSH, containing respectively 13 and 18 amino acid residues have been isolated.<sup>68,69</sup> The human pituitary lacks  $\alpha$ -MSH, but produces a  $\beta$ -MSH with 22 residues. However, it seems likely that the active sequence is actually part of two larger molecules,  $\beta$ -lipoprotein with 91 amino acids and  $\gamma$ -lipotropin with 58.<sup>70</sup>

There are long-standing reports that testosterone increases skin pigmentation in castrated men<sup>71,72</sup> and in women.<sup>73</sup> The same may be true for certain specialized areas of skin in some animals, but experimental studies on the guinea pig failed to reveal any effect of androgens,<sup>74,75</sup> though oestrogens clearly increased skin pigmentation in a number of areas.<sup>76,77</sup>

The major function of melanin is undoubtedly protection against solar radiation.<sup>78–80</sup> In general, pigment is geographically distributed in relation to the solar intensity experienced by the various ethnic groups, being greatest in the tropics, reduced in temperate zones, and partly reappearing in areas of snow-glare.<sup>81</sup> There are exceptions: for example, American Indians do not noticeably differ in colour throughout the continent. The damaging effects of ultraviolet light are well illustrated by the high incidence of epidermal carcinoma in Europeans exposed to the tropical sun. Melanin pigmentation may be useful in two ways. As well as providing direct protection from radiation, it may be activated to a free radical state by incident light and thus could possibly eliminate genetically damaged cells by a phototoxic mechanism.

### Langerhans Cells

Langerhans cells are dendritic cells similar in form to melanocytes but free from pigment and unable to form it when they are incubated with dihydroxyphenylalanine (that is, they are dopa-negative). They were first demonstrated in human

skin by the use of gold chloride<sup>82</sup> and can be stained with ATPase.<sup>83</sup> Under the electron microscope they resemble melanocytes in having a lobulated nucleus, but differ in lacking melanosomes, having instead characteristic granules which are rod- or racquet-shaped.<sup>84-88</sup>

The origin and affinities of Langerhans cells have been much debated, and their function remains undecided. The view that they are effete melanocytes is discarded.<sup>89-91</sup> It is currently believed that Langerhans cells are of mesenchymal origin and equivalent or closely related to dermal histiocytes,<sup>92</sup> in which identical granules have been described.<sup>93-96</sup> Various possible functions have been ascribed to them. For example, opinion is divided about whether they may<sup>97</sup> or may not<sup>98,99</sup> control proliferation of keratinocytes and the pattern of epidermal cell columns. Another suggested role might be the loosening of intercellular connections.<sup>100,101</sup> Langerhans cells are capable of limited phagocytosis, but they should not be regarded as functional macrophages.<sup>102,103</sup> Recently attention has become focussed on the possibility that they are concerned with immune functions.

## Dermis

The *dermis*<sup>1,104,105</sup> is a tough and resilient tissue which cushions the body against mechanical injury and provides nutriment to the epidermis and cutaneous appendages. It consists of an association of protein fibres with an amorphous ground substance containing mucopolysaccharide. There are few cells in this matrix; most of them are *fibroblasts* which secrete the dermal constituents; others are *mast cells*, histiocytes or macrophages, lymphocytes and other leucocytes, and melanocytes. The dermis also houses blood, lymphatic and nervous systems, and surrounds the invaginated epidermal appendages, namely the hair follicles, with its associated glands and the eccrine sweat glands.

## Collagen

The major fibrous constituent of the dermis, accounting for 75 per cent of the dry weight and 18-30 per cent of the volume, is *collagen*.<sup>105-111</sup> Under the light microscope collagen fibres appear as colourless, branching wavy bands about 15  $\mu\text{m}$  in width. The electron microscope reveals that each fibre is composed of unbranched fibrils about 100 nm (1000 Å) wide and is characteristically cross-striated with a periodicity of 60-70 nm. Collagen fibres can be disintegrated by 0.01 per cent acetic acid, forming molecules with a molecular weight of 300 000-360 000, about 180 nm long. When these acid solutions of *tropocollagen* are neutralized, the 64 nm periodicity reappears, which may be explained on the hypothesis that native collagen is composed of molecules of tropocollagen associated side by side with a regular overlap of a quarter of their length.<sup>112</sup>

Skin collagen is characterized by a high content of glycine, which forms a third of all the residues, and of proline and hydroxyproline, which together make up a further fifth. Tropocollagen molecules<sup>107</sup> consist of three polypeptide chains each containing about 1000 amino acids. The fibroblasts produce a precursor known as *procollagen* which has 300-400 additional amino acids in each of its chains; these extensions are removed after secretion.<sup>113,114</sup>

### *Elastin and Reticulin*

*Elastic fibres*<sup>115-124</sup> make up 4 per cent of the dry weight and 1 per cent of the volume of the dermis. They are delicate, straight, freely branching fibres which can be stretched by 100 per cent or more but return to their original length when the stress is removed. Elastin differs from collagen in having only about a quarter or a third the amount of basic and acid amino acids, only one tenth the amount of hydroxyproline, a relatively large amount of valine, and an amino acid known as desmosene<sup>125</sup> which appears to be unique to it and to be concerned with cross-linkage.

Not all fibrous constituents can be clearly identified as collagen or elastin on the basis of their tinctorial properties. In addition to true elastin, two other similar fibres have been distinguished and given the names of oxytalan and elaunin.<sup>126</sup> Moreover, about 0.4 per cent of the dry weight of the dermis is made up of fine branching fibres which, unlike collagen, stain black with silver nitrate, and are known as *reticulin*. Their axial periodicity is identical with that of collagen.<sup>116</sup>

### *Ground Substance*

The amorphous ground substance<sup>127-135</sup> in which the fibres and cells lie contains a variety of carbohydrates, proteins and lipids, of which the most important are the acid mucopolysaccharides. These are macromolecules made up of two different saccharide units which alternate regularly. In dermis the major forms are *hyaluronic acid*, in which D-glucosamine, with an acetylated amino group, alternates with D-glucuronic acid, and *dermatan sulphate*, in which L-iduronic acid alternates with D-galactosamine.

### *Fibroblasts*

The term *fibroblast*<sup>105,136,137</sup> should, strictly, designate a cell at any early stage and *fibrocyte* one which is fully differentiated,<sup>138</sup> but most authors use fibroblast to describe an actively secreting cell and fibrocyte for an inactive one.<sup>105</sup> Fibroblasts are derived from the mesenchyme. It is not doubted that fibroblasts secrete collagen.<sup>139</sup> It is probable that they are the source of elastin<sup>140</sup> and, though Asboe-Hansen<sup>141</sup> has implicated the mast cell, also of mucopolysaccharides.<sup>142</sup>

### *Mast Cells*

Mast cells<sup>143-146</sup> also originate from wandering cells of the mesenchyme. They are characterized by a cytoplasm filled with granules which stain metachromatically with basic aniline dyes—purple with methylene blue. They contain, and can release, heparin and histamine. Rupture of the cells, with release of the granules, is observed in many types of skin damage, and histamine is responsible for many of the events associated with inflammation, irritation and other skin disorders. This subject is dealt with at greater length in the next chapter.

## **Nerves and Sense Organs**

The skin is innervated with about one million afferent nerve fibres; most terminate in the face and extremities; relatively few supply the back.

Sensory endings fall into two major groups: corpuscular, which incorporate non-nervous elements, and free, which do not.<sup>147-152</sup> Corpuscular endings, in turn, are subdivided into encapsulated receptors, of which there is a range in the dermis, and non-encapsulated, such as the epidermal Merkel 'touch spot'.<sup>153,154</sup>

The largest encapsulated receptors are the elaborate *Pacinian corpuscles*<sup>155,156</sup> which are ovoid bodies about 1 mm in length and lamellated in cross-section like an onion. Others are the *Golgi-Mazzoni corpuscles* found in the subcutaneous tissue of the finger, the *Krause end-bulbs* in the superficial layers of the dermis, and the *Meissner corpuscles*<sup>147,151,152,157</sup> in the papillary ridges of the glabrous skin. Of somewhat different structure are the branching terminals of *Ruffini*.<sup>151</sup>

Free nerve endings occur both in the dermis and in the epidermis. Hair follicles have nerve terminals of varying degrees of complexity.

The way these miscellaneous receptors function has been much debated. As it is easy to map separate sensory spots for the several kinds of stimuli, the classical view was that receptors were specific for the qualities of touch (Meissner's corpuscles), warmth (Ruffini end-organs), cold (Krause end-bulbs) and pain (free nerve endings). The hypothesis came under attack on the grounds that it did not explain why hairy skin could also distinguish between the stimuli, even though it lacked the encapsulated structures.<sup>158</sup>

The existence of functionally specific afferent units has in recent years been reaffirmed by electrophysiological experiments. Two major categories of units have been established: mechanoreceptors and thermoreceptors,<sup>150,151</sup> and a third category, pain receptors, respond only to high threshold stimulation, mechanical, thermal or chemical. Mechanoreceptors have been further classified into 'slowly adapting', as exemplified by the Ruffini endings and Merkel cells, and 'rapidly adapting', namely the hair follicle receptors, Meissner corpuscles, and the laminated Pacinian and Golgi-Mazzoni corpuscles.<sup>159</sup>

The autonomic nervous system supplies both adrenergic and cholinergic fibres to the arrector pili muscles and the blood vessels. Stimulation of the arrector pili muscle by its associated nerve causes the hair shaft to rise to a more perpendicular position with respect to the skin surface. This slows down the passage of air over the skin and consequently reduces the rate of heat loss. This phenomenon is the cause of 'goose flesh'. Regulation of the amount of blood flowing through the superficial layers of the dermis also influences heat loss (see next section).

Eccrine sweat glands are also richly supplied with nerves.<sup>160</sup> Anticholinergic substances are able to inhibit sweating, and most of the nerves appear to be cholinergic, though a few adrenergic fibres can be demonstrated. It seems likely that the glands of the palms and soles, which secrete sweat to increase the grip of the skin, are influenced by adrenergic fibres, whereas those of the general body surface, which regulate body heat, are under cholinergic control.<sup>161</sup>

### Blood Vessels

The arteries entering the skin form a deep plexus, from which a network arises which gives branches to the cutaneous appendages and to a subpapillary plexus, which in turn sends loops into the papillary layer just below the dermo-epidermal frontier. From these capillaries the blood is drained by veins which descend into the intermediate plexuses.<sup>162-164</sup>

All the nutriment for the epidermal cells has to pass through the dermo-epidermal junction; no blood vessels enter the epidermis. The vasculature is much more elaborate than would be necessary solely for nutrition; indeed, the metabolic rate in skin is lower than in many less well-perfused organs. Temperature control thus appears to be a most important function. When the superficial loops are fully dilated, the skin appears flushed and heat loss is at a maximum. However, shunts are provided between arterial and venous systems deeper in the dermis which can carry all or most of the blood when heat loss must be kept to a minimum. In these circumstances the superficial capillary loops are found to be almost completely closed.

The regulation of the total blood volume in the skin as opposed to its distribution is mediated by constriction and dilation of the cutaneous circulation, and allows a large reservoir of blood to be made rapidly available for vital central functions in times of stress. The mechanism of constriction of the lumen of a blood vessel in the dermis can be either by a general activation of contractile myoepithelial cells in the wall of the capillary, or by activation of 'glomerulae' which are small contractile cuffs around the vessel, and which effectively strangle the vessel and cut the blood flow. The operations of constriction and dilation are mediated via the local secretion of chemicals (for example acetylcholine) from nerves, hormones (for example adrenalin) and, in cases of skin damage, histamine from the mast cells in the dermis.

As distinct from this widely held view, Ryan<sup>165</sup> has stressed the oxygenating function of the vasculature in a tissue which is exposed to many kinds of injury. Finally, it must be remembered that the blood supply carries all the materials for making the products of the hair follicle and its associated glands, as well as the hormones which influence their manufacture, and the substances which are excreted by the sweat glands.

### **Eccrine Sweat Glands**

Eccrine sweat glands<sup>166</sup> are the most numerous skin appendages and occur over the majority of the body surface. In some areas they number as many as  $600 \text{ cm}^{-2}$ . They have a cylindrical spiral duct lined with epidermal cells extending from their visible opening in the epidermis down into the deep dermis where the duct becomes coiled and convoluted into a ball (Figure 1.4). Part of the tangled duct is secretory and manufactures the odourless sweat which rises up the duct to be released on the skin surface. It is thought that the duct of the gland has the ability to modify the sweat as it flows upward, by removing salts or water.<sup>167</sup> The analogy with the nephron of the kidney is frequently drawn. Though the lining of the duct is said to be epidermal, it is not highly pigmented even in people with pigmented skin.

The sweat glands of the general body surface are concerned with both control of body temperature and excretion. The evaporation of sweat has a cooling effect. The glands thus respond to environmental temperature, but also to other stimuli, such as ultraviolet light, emotional stress and rises in body temperature due to fevers. On the palms and soles, however, the secretion from the glands serves to increase surface friction. In both areas, sweating is under nervous control, though different types of fibre may be involved (see previous section).

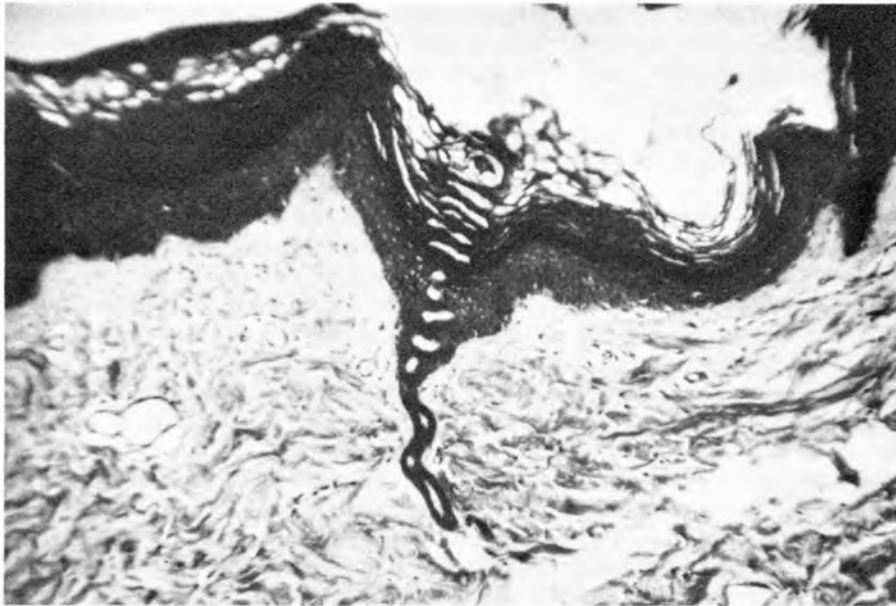


Figure 1.4 Section of human toe skin showing a spiralling sweat duct (magnification  $\times 140$ ): invagination of the epidermal tissue along the length of the duct can be clearly seen

Sweating appears to involve activation of myoepithelial cells which line the ducts of the glands. Although sweating is considered to be a continuous process, it seems that sweat is ejected in small bursts, perhaps 6–7 per minute, suggesting a peristaltic action by the ducts.<sup>168</sup> The composition of eccrine sweat is variable but consists of electrolyte ions, urea, amino acids, small quantities of sugars and possibly some lipid. The normal range of sodium chloride concentration in eccrine sweat is stated to be between 10 and 100 milli-equivalents per litre.<sup>169</sup>

### Hair Follicles

Hair follicles are tubular inpushings of the epidermis. The hair is produced by keratinization of cells formed by division in the matrix at the base of the follicle.<sup>170–174</sup> This epidermal matrix surrounds a small dermal papilla which becomes invaginated into its base.

There are about 120 000 follicles on the human scalp. Each one undergoes a cycle of activity<sup>174</sup> in which an active phase (anagen), which lasts for 1 to 3 years or even longer, is followed by a short transition phase (catagen) and a resting phase (telogen) (see Figure 23.2). This process involves a cessation of mitosis in the matrix and the keratinization of the expanded base of the hair to form a 'club', which is retained until the follicle again becomes active, when it is shed (Figure 23.3). Thus about 100 hairs are normally lost from the scalp each day.<sup>175,176</sup>

Such cyclic activity of hair follicle may be considered as a remnant of the moult in other mammals. In contrast to the human scalp, where the activity of each follicle appears to be independent of its neighbours, some animals, such as rats and mice, exhibit wavelike patterns of new hair growth and moulting, which start in the mid-venter and spread over the flanks to the back.<sup>177</sup> These have proved interesting models for experimentation on the factors controlling hair growth, but it should not be supposed that this has any direct relevance to human baldness. It appears that hair follicles have an intrinsic rhythm, of which the mechanism remains undiscovered, but that this can be greatly modified by circulating hormones and thus, in turn, by environmental factors acting through the hypothalamus and the pituitary.<sup>177,178</sup> Thus moulting, like reproductive activity, is seasonally controlled. Perhaps even the human scalp retains a reflection of the seasonal moult, with increased shed of club hairs in the autumn.<sup>179</sup>

In the axillary and pubic regions of both sexes, and on the face of the male, coarse *terminal* hair—as distinct from fine *vellus*—develops at puberty, and continues to increase in amount for several years.<sup>180</sup> The growth of this hair is initiated by and dependent upon androgens (male steroid hormones) which are secreted by the testicles of the male and by the adrenal glands and the ovaries in the female. Male-type body hair is also androgen-dependent, though its amount and distribution vary greatly between individuals. Unacceptable amounts of facial and body hair in women, known as *hirsutism*, may result from abnormal high androgen production, but individual variations in the sensitivity of the target hair follicles is also important. Compounds which block the action of androgen, known as *anti-androgens*, offer possibilities for the alleviation of female hirsutism.<sup>181</sup>

Male pattern alopecia, a condition in which vigorously growing terminal hair is gradually replaced by miserably small and cosmetically useless fibres over areas of the scalp, appears to be hereditary, but requires the presence of male hormone. Hence eunuchs, even if genetically disposed, do not go bald, unless treated with testosterone,<sup>182</sup> and women rarely develop conspicuous bald patches, though they frequently suffer diffuse hair loss which may be the female equivalent. Why male hormones should promote hair growth on the face and body and ruin it on the vertex of the scalp, so far eludes any consistent explanation.

The structure and growth of hair is further considered in Chapter 23.

### Sebaceous Glands

Sebaceous glands<sup>183,184</sup> secrete sebum, which forms the majority of the lipid which covers the skin and hair. They occur throughout most of the body and are normally, though not invariably, associated with hair follicles. The greatest concentrations (400–900 cm<sup>-2</sup>) are found on the scalp, face and upper chest and shoulders, and there are none on the palms and soles.

The glands are *holocrine*, that is to say the cells of the gland pass through a development and maturation stage, during which they accumulate lipid, becoming several times their original size, and subsequently disintegrate completely,

releasing their contents into the lumen of the gland. New cells are formed continually from the lining of the gland by cell division to replace those lost.

Sebaceous gland activity is under hormonal control. It is stimulated by androgens. In human males, the glands are minute during the prepubertal period, but undergo vast enlargement at puberty when the output increases more than fivefold.<sup>185</sup> Eunuchs secrete about half as much sebum as normal males, but substantially more than boys; it seems that the secretion is dependent on adrenal androgens. Adult women secrete only a little less than men; their sebaceous activity appears to be maintained by androgens from the ovary as well as from the adrenal cortex.

Circumstantial evidence from man, and experimental evidence from animals, indicates that pituitary hormones may also influence sebaceous secretion. Sebum secretion is abnormally high in acromegalics.<sup>186</sup> The response of the rat sebaceous glands to testosterone is greatly diminished when the pituitary is removed. Bovine growth hormone<sup>187</sup> and synthetic  $\alpha$ -MSH<sup>188,189</sup> have each been shown to have some direct effect on sebaceous secretion, and to facilitate the response of the glands to testosterone.

Oestrogens, or anti-androgens such as cyproterone acetate, will inhibit sebaceous secretion in man<sup>181</sup> as well as in rats.<sup>190</sup>

Human sebum<sup>191</sup> is composed of glycerides and free fatty acids (57.5 per cent), wax esters (26.0 per cent), squalene (12.0 per cent), cholesterol esters (3.0 per cent) and cholesterol (1.5 per cent). Lipid produced from the superficial epidermis differs in lacking wax esters and squalene, and having much higher proportions of cholesterol esters and cholesterol. Skin lipids appear to differ greatly between species.

### Apocrine Glands

The so-called *apocrine glands*<sup>192</sup> are tubular glands attached to the hair follicle and, like the sebaceous glands, developed in association with it. Though rudiments are formed throughout the body in the foetus, the glands become canalized and functional almost exclusively in the axillary, anal and genital regions and in the areola of the nipple; few are found elsewhere. The axillary glands only become functional at puberty and it seems probable that, like similar derivatives in other animals, for example the rabbit,<sup>193</sup> they are androgen-sensitive.

The secretion of human apocrine glands is milky, viscous and at first without noticeable odour, which is said to develop through bacterial action. Secretory activity is controlled by adrenergic nerves.

The function of the glands in the human species has been much debated. In many other mammals they constitute or contribute to scent glands. Odour is undoubtedly important in human communication,<sup>194,195</sup> though little information has been recorded since Havelock Ellis wrote down his entertaining if anecdotal evidence.<sup>196</sup>

### Common Disorders of the Skin

The cosmetic chemist is concerned not with serious clinical disorders of the skin but with lesser, if often chronic, conditions that affect large numbers of the



population and which are only presented to the clinician when extremely severe. Discussion in this chapter is confined to a few which appear to come within the purview of the cosmetic scientist. For detailed accounts of these and of other disorders the reader is referred to textbooks of dermatology.<sup>197,198</sup>

#### *Pigmentary Disorders*

*Ephelides, Lentigens and Moles.* It is not easy to discover a consistent classification for the small hyperpigmented areas which occur on the skin of most Caucasians. It is generally agreed that freckles (ephelides) are pale, variably coloured, not usually raised, and harmless. Their pigmentation is due to an increased local synthesis of melanin in the epidermis. The predispositions for these are apparently genetically determined. They are found predominantly on the exposed areas of fair or red-haired people and are stimulated by exposure to UV or X-irradiation. Children do not usually have freckles until after their sixth year of life.

It is usually considerations of degree which differentiate between freckles and the more pronounced lentigens which are generally associated with age, and moles (junctional naevi). These latter are usually more heavily pigmented, fewer in number and are associated with a thickening of the epidermis. They are rarely present at birth, and in women become considerably darker during pregnancy, as do other areas.<sup>200</sup> It should be mentioned that in the most severe cases these naevi can become malignant but this will not be considered further in this book.

*Vitiligo.* Apart from hyperpigmented disorders there are considerable cosmetic problems associated with hypopigmentation diseases, the most common of which is vitiligo, a patchy depigmentation of the skin afflicting a considerable number of non-Caucasians. Although it does occur in Caucasians, it is not usually cosmetically troublesome. This condition has been referred to by a former Prime Minister as 'India's national disease'. It is the more distressing on account of its resemblance to the early stages of leprosy, when depigmentation also occurs, and therefore it can carry a social stigma without any foundation.

Vitiligo is usually associated with an absence not only of melanin but of melanocytes in the affected areas. The aetiology is unknown. It frequently exhibits a degree of bilateral symmetry and is also seen to follow superficial nerve trunks, but there is little support for the hypothesis that it is linked with nerve function.<sup>201</sup> An autoimmune hypothesis is based on its clinical association with a number of other supposedly autoimmune disorders.<sup>202</sup>

Vitiligo has been treated by systemic psoralens (photosensitizing compounds obtained from certain umbelliferous plants) followed by exposure to the sun or UV radiation,<sup>203</sup> or by topical corticosteroid preparations.<sup>204</sup> Treatments are usually not very satisfactory, and cosmetic camouflage is often the best recourse.

#### *Disorders of the Sebaceous and Sweat Glands*

*Acne vulgaris*<sup>205-207</sup> is a chronic disorder of the pilosebaceous follicles which is so frequent among Caucasoids as to be regarded as physiological in adolescents.

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## Proprietary Materials Cited in this Book

Entries in italics are the CTFA adopted names as listed in the *CTFA Cosmetic Ingredient Dictionary*; they are reprinted with the permission of the Cosmetic, Toiletry and Fragrance Association, Inc., Washington DC, USA.

It should be noted that CTFA does not 'approve', 'certify' or 'endorse' particular ingredients for use in cosmetic products. CTFA has a committee that assigns 'adopted names' to certain cosmetic ingredients for inclusion in the *CTFA Cosmetic Ingredient Dictionary*, which is recognized by regulations of the United States Food and Drug Administration (Title 21, Code of Federal Regulations, Section 701.3) as an authoritative reference of proper nomenclature of an ingredient for purposes of cosmetic ingredient labelling. Assignment of an 'adopted name' and inclusion in the *Dictionary* establishes only proper *nomenclature* for an ingredient for purposes of ingredient labelling on cosmetic products sold in the United States; it does *not* signify CTFA (or FDA) 'approval' of the ingredient.

In the interests of achieving uniform nomenclature for ingredients available for use in the cosmetic industry, the CTFA adopted names are becoming increasingly used in countries other than the United States of America.

Proprietary name	Chemical description	Supplier
Acetol	<i>Acetylated lanolin alcohol</i>	Emery
Actamer	2,2-Thiobis-(4,6-dichlorophenol)	Monsanto
Aduvex 2211	2-Hydroxy-4-methoxy-4'-methylbenzophenone	Ward Blenkinsop
Aerosil	Finely divided silica	Degussa
Aerosol OT	Diethyl sodium sulphosuccinate	American Cyanamid
Aethoxal	Ethoxylated propoxylated fatty alcohol <i>PPG-10-Ceteareth-20</i>	Henkel
Alcloxa	Aluminium chlorhydroxy allantoinate <i>Alcloxa</i>	Hoechst
Alrosal	Fatty acid amide concentrate	Ciba-Geigy
Amerchol CAB	Cholesterol absorption base <i>Petrolatum</i> and <i>Lanolin Alcohol</i>	Amerchol
Amerchol L-101	Mineral oil and lanolin alcohols	Amerchol
Aminoxid WS35	Cocamidopropylamine oxide	Goldschmidt

Proprietary name	Chemical description	Supplier
Ammonyx 4002	Benzyl dimethyl stearyl ammonium chloride <i>Stearalkonium Chloride</i>	Onyx
Amphomer	<i>Octylacrylamide/Acrylates/Butyl-aminoethyl Methacrylate Polymer</i>	National Starch
ANM starch powders	Starch ethers	Neckar-Chemie
Anobial	3',4',5-Trichlorosalicylanilide	Firmenich
Anobial TFC	3-Trifluoromethyl-4,4'-dichlorocarbanilide	Firmenich
Antara opacifiers		GAF
Antifoam AF	Mixture of dimethylpolysiloxane ( <i>dimethicone</i> ) and silica gel <i>Simethicone</i>	Dow Corning
Antiviray	Homomenthyl salicylate ( <i>Homosalate</i> ), benzyl salicylate and methyl eugenol	Bush Boake Allen
Arlacel A	Mannide mono-oleate	ICI
Arlacel C	<i>Sorbitan Sesquioleate</i>	ICI
Arlacel 83	<i>Sorbitan Sesquioleate</i>	ICI
Arlacel 165	Glycerylmonostearate and polyoxyethylene stearate <i>Glyceryl Stearate and PEG-100 Stearate</i>	ICI
Arlamol E	Fatty acid propoxylate <i>PPG-15 Stearyl Ether</i>	ICI
Arlatone T	Sorbitan polyoxyethylene fatty acid ester <i>PEG-40 Sorbitan Peroleate</i>	ICI
Arlex	<i>Sorbitol</i>	ICI
Arochlor 5460		Monsanto
Arquad 2HT	Dimethyldi (hydrogenated tallow) ammonium chloride <i>Quaternium-18</i>	Armaq
Arquad 16	Alkyltrimethylammonium chloride <i>Cetrimonium Chloride</i>	Armaq
Arquad S50	Trimethylsoy ammonium chloride <i>Soyatrimonium Chloride</i>	Armaq
Atlas G-271	N-soya-N-ethylmorpholinium ethosulphate <i>Quaternium-2</i>	ICI
Atlas G-1086	Polyethylene glycol sorbitol hexaoleate	ICI
Atlas G-1425	Polyoxyethylene sorbitol lanolin derivative	ICI

Proprietary name	Chemical description	Supplier
Atlas G-1441	Polyoxyethylene sorbital lanolin derivative <i>PEG-40 Sorbitan Lanolate</i>	ICI
Atlas G-1690	Polyoxyethylene ether of alkyl phenol	ICI
Atlas G-1790	Polyoxyethylene lanolin condensate <i>PEG-20 Lanolin</i>	ICI
Atlas G-2132	Polyoxyethylene lauryl ether	ICI
Atlas G-2240	Polyoxyethylene sorbitol	ICI
Atlas G-2320	Polyoxyethylene sorbitol	ICI
Atlas G-2859	Polyoxyethylene sorbitol 4, 5-oleate	ICI
Atlas G-3721	Polyoxyethylene-2-butyl octanol	ICI
Atlas G-7596J	Polyoxyethylene sorbitan monolaurate <i>PEG-10 Sorbitan Laurate</i>	ICI
Avicel	Microcrystalline cellulose	FMC
Avitex ML	Cationic emulsifying agent	DuPont
Bentones	Quaternary hectorites	NL Industries
Bentonite	Clay mineral, montmorillonite <i>Bentonite</i>	Berk
Betadine	Iodophor (i.e. mixture of iodine with surface-active agent)	Berk
BHT	Butylated hydroxytoluene (i.e. 2,6-di- <i>tert</i> -butyl-4-methylphenol) <i>BHT</i>	Kodak Chemical
Bithionol	2,2'-thio-bis-(4,6-dichlorophenol)	Hilton Davis Chemicals
Bradosol	$\beta$ -Phenoxyethyl dimethyldodecylammonium bromide	CIBA
Brij 30	Polyoxyethylene lauryl ether <i>Laureth-4</i>	ICI
Brij 35	Polyoxyethylene lauryl ether <i>Laureth-23</i>	ICI
Brij 93	Polyoxyethylene (2) oleyl ether <i>Oleth-2</i>	ICI
Bronopol	<i>2-Bromo-2-Nitropropane-1,3-Diol</i>	Boots
BTC	Lauryldimethylbenzylammonium chloride	Onyx
BTC 2125M	Tetradecyldimethylbenzylammonium and dodecyldimethyl- <i>p</i> -ethylbenzylammonium chlorides <i>Myristalkonium Chloride</i> and <i>Quaternium-14</i>	Onyx
Cab-o-sil	Fumed silica	Cabot

Proprietary name	Chemical description	Supplier
Calflo E	Calcium silicate	Johns-Manville
Carbopol 934	Polymer of acrylic acid cross-linked with a polyfunctional agent <i>Carbomer-934</i>	Goodrich
Carbopol 940	Polymer of acrylic acid cross-linked with a polyfunctional agent <i>Carbomer-940</i>	Goodrich
Carbopol 941	Polymer of acrylic acid cross-linked with a polyfunctional agent <i>Carbomer-941</i>	Goodrich
Carbopol 960	Ammonium salt of Carbopol 934 <i>Carbopol-960</i>	Goodrich
Carbowax 400	Ethylene oxide polymer <i>PEG-8</i>	Union Carbide
Carbowax 1000	Ethylene oxide polymer <i>PEG-20</i>	Union Carbide
Carbowax 1500	Ethylene oxide polymer <i>PEG-6-32</i>	Union Carbide
Carbowax 1540	Ethylene oxide polymer <i>PEG-32</i>	Union Carbide
Carbowax 4000	Ethylene oxide polymer <i>PEG-75</i>	Union Carbide
Carbowax 6000	Ethylene oxide polymer <i>PEG-150</i>	Union Carbide
Catrex	Interpolymer of aminoethylacrylate phosphate and acrylic acid <i>Aminoethylacrylate Phosphate/Acrylate</i>	National Starch
Ceepryn	Cetylpyridinium bromide or chloride	Merrell
Celacol	Sodium carboxymethylcellulose	British Celanese
Cellofas	Sodium carboxymethylcellulose	ICI
Cellosize	<i>Hydroxyethylcellulose</i>	Union Carbide
Ceraphyl 60	$\gamma$ -Gluconamidopropyl dimethyl-2-hydroxyethylammonium chloride <i>Quaternium-22</i>	Van Dyk
Ceraphyl 65	Mink aminopropyl dimethyl-2-hydroxyethylammonium chloride <i>Quaternium-26</i>	Van Dyk
Cetavlon	Cetyltrimethylammonium bromide	ICI
Cetiol HE	Polyol fatty acid ester <i>PEG-7 Glycerol Cocoate</i>	Henkel
Chlorhexidine	1,6-di-(N-p-chlorophenylguanidino)hexane <i>Chlorhexidine</i>	ICI

Proprietary name	Chemical description	Supplier
Chlorhydrol	Aluminium chlorhydrate, 50% solution <i>Aluminium Chlorohydrate</i>	Reheis
Comperlan HS	Stearic monoethanolamide	Henkel
Comperlan KD	Cocamide diethanolamide <i>Cocamide DEA</i>	Henkel
Course	Sodium carboxymethylcellulose	British Celanese
Crillet 3	Mixture of stearate esters of sorbitol and sorbitol anhydrides condensed with approx. 20 moles of ethylene oxide <i>Polysorbate 60</i>	Croda
Crodafos N3 acid	Phosphated oleyl ether (3EO) <i>Oleth-3 Phosphate</i>	Croda
Crodafos N3 neutral	Diethanolamine salt of a complex mixture of esters of phosphoric acid and <i>Oleth-3</i> (which is the polyethylene glycol ether of oleyl alcohol) <i>DEA-Oleth-3 Phosphate</i>	
Crodalan IPL	<i>Isopropyl lanolate</i>	Croda
Crodamol CSP	Cetostearyl palmitate	Croda
Crodamol IPP	<i>Isopropyl Palmitate</i>	Croda
Crodamol ML	<i>Myristyl Lactate</i>	Croda
Crodamol OP	<i>Octyl Palmitate</i>	Croda
Crodaterge LS (now named Crodasinic LS)	<i>Lauroyl Sarcosine</i>	Croda
Crodaterge OS (now named Crodasinic OS)	<i>Oleoyl Sarcosine</i>	Croda
Crodesta F70, F160 and F110	Sucrose esters of palmitic acid and stearic acids	Croda
Cromeen	Substituted alkyl amine derivative of various lanolin acids	Croda
Crotein Q	Quaternized hydrolysed animal protein	Croda
DC 200	Dimethylpolysiloxane	Dow Corning
Dehyquart SP	Ethoxylated quaternary ammonium phosphate <i>Quaternium-52</i>	Henkel
Deriphat 170C	Lauryl aminopropionic acid <i>Lauraminopropionic Acid</i>	General Mills
Detergent 1011	Secondary amide of lauric acid	
Dichlorophene	2,2-methylene-bis-(4-chlorophenol)	Givaudan
Dicrylan 325	Acrylate/acrylamide polymer	Ciba-Geigy

Proprietary name	Chemical description	Supplier
Diometam	Di-(n-octyl)-dimethylammonium bromide	British Hydrological
Dioxin	6-Acetoxy-2, 4-dimethyl- <i>m</i> -dioxane	Givaudan
Dowfax 2A		Dow
Dowicil 200	1-(3-chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride <i>Quaternium-15</i>	Dow
Duponol C	Sodium lauryl sulphate	DuPont
Duponol WA	Sodium lauryl sulphate	DuPont
Duponol WAT	Triethanolamine salt of lauryl sulphate <i>TEA-Lauryl Sulfate and TEA-Oleyl Sulfate</i>	DuPont
Edifas	Sodium carboxymethylcellulose	ICI
Emcol CD-18	Propoxylated polyol	Witco
Emcol E-607	<i>N</i> -(Acylcolaminoformylmethyl) pyridinium chloride	Witco
Emcol E-6075	<i>N</i> -Stearoylcolaminoformyl-methylpyridinium chloride <i>Quaternium-7</i>	Witco
Emerest 2400	<i>Glyceryl Stearate</i>	Malmstrom
Emersol 132	Stearic acid	Malmstrom
Empicol LZ	Sodium lauryl sulphate	Albright & Wilson
Empigen BB	Alkyl dimethyl betaine	Albright & Wilson
Empigen BT	Alkyl amido betaine	Albright & Wilson
Empigen CDR10	Coconut imidazoline betaine	Albright & Wilson
Empigen CDR30	Modified coconut imidazoline betaine	Albright & Wilson
Emsorb 6915	<i>Polysorbate 20</i>	Malmstrom
Escalol 506	Amyldimethyl- <i>p</i> -aminobenzoic acid <i>Amyl Dimethyl PABA</i>	Van Dyk
Estol 1461	Glycerol monostearate nse	Unichema
Ethomeen C/25	<i>PEG-15 Cocamine</i>	Armak
Eutanol G	2-Octyldodecanol <i>Octyl Dodecanol</i>	Henkel
Eutanol LST		Henkel
Evanol	Proprietary cream base	Evans Chemetics
Extrapones	Herbal extracts	Dragoco
Fentichlor	<i>Bis</i> -(2-hydroxy-5-chlorophenyl) sulphide	Cocker Chemical
F.H.P.	Sodium carboxymethylcellulose	Hercules

Proprietary name	Chemical description	Supplier
Filtrosol A-1000 and B	UV screens—proprietary mixtures	Norda
Fixanol C	Cetylpyridinium bromide or chloride	ICI
Fixanol VR	Tetradecylpyridinium bromide	ICI
Fluilanol	Lanolin oil and <i>Oleth-3</i> (which is the polyethylene glycol ether of oleyl alcohol)	Croda
Fluorophene	3,5-dibromo-3'-trifluoromethylsalicylanilide <i>Fluorosalan</i>	Pfister
F.M.P.	Sodium carboxymethylcellulose	Hercules
Foromycen F10	Antifungal agent	Petrosin Laboratorium
Fungicide DA	Undecylenamide diethanolamide <i>Undecylenamide DEA</i>	Dragoco
Fungicide UMA	Undecylenamide monoethanolamide <i>Undecylenamide MEA</i>	Dragoco
Gafquat 734 and 755	Quaternary ammonium polymers formed by the reaction of dimethyl sulphate and a copolymer of vinyl pyrrolidone and dimethylaminoethylmethacrylate <i>Quaternium-23</i>	GAF
Gantrez ES-225	Monocethyl ester of methylvinylether/maleic acid copolymer (50% in ethanol) <i>Ethyl ester of PVM/MA copolymer</i>	GAF
Gantrez ES-425	Monobutyl ester of methylvinylether/maleic acid copolymer (50% in ethanol) <i>Butyl ester of PVM/MA copolymer</i>	GAF
Genapol S200		Hoechst
Germall 115	Imidazonidyl urea	Sutton Laboratories
Giv-tan F	2-Ethoxy- <i>p</i> -methoxycinnamate <i>Cinoxate</i>	Givaudan
Glucam-P20	<i>PPG-20 methylglucose ether</i>	Amerchol
HD Eutanol	Oleyl alcohol	Henkel
Hexachlorophene	2,2'-methylene- <i>bis</i> -(3,4,6-trichlorophenol)	Givaudan
Hibitane	1,6-di-( <i>N-p</i> -chlorophenylguanidino) hexane	ICI
Hostaphat KL340N	Triester of the polyethylene glycol ether of lauryl alcohol and phosphoric acid <i>Trilaureth-4 Phosphate</i>	Hoechst



<b>Proprietary name</b>	<b>Chemical description</b>	<b>Supplier</b>
Hostapur SAS	Secondary alkane sulphonate	Hoechst
Hyamine 10X	Methylbenzethonium chloride	Rohm & Haas
Hyamine 1622	<i>p</i> -Diisobutylphenoxyethoxyethyl-dimethylbenzylammonium chloride <i>Benzethonium Chloride</i>	Rohm & Haas
Hyamine 2389	Alkyltolylmethyltrimethylammonium chloride <i>Quaternium-28</i> and <i>Quaternium-29</i>	Rohm & Haas
Ionol	Butylated hydroxytoluene, i.e. 2,6-di- <i>tert</i> -butyl-4-methylphenol <i>BHT</i>	Shell
Ionol CP	Purified grade of Ionol <i>BHT</i>	Shell
Irgasan BS200	3,3',4,5'-Tetrachlorosalicylanilide	Ciba-Geigy
Irgasan CF-3	3-Trifluoromethyl-4,4'-dichlorocarbaniide <i>Cloftucarban</i>	Ciba-Geigy
Irgasan DP-300	2,4,4'-Trichloro-2'-hydroxydiphenylether <i>Triclosan</i>	Ciba-Geigy
Isopar E	Isoparaffinic solvent	Esso
Isopropylan 33	<i>Isopropyl Lanolate</i> and <i>Lanolin oil</i>	Robinson-Wagner
Isothan Q	Alkylisoquinolinium bromide	Onyx
Isothan Q-15	<i>Lauryl Isoquinolinium Bromide</i>	Onyx
Kelzan	<i>Xanthan gum</i>	Kelco
Klucel	<i>Hydroxypropylcellulose</i>	Hercules
Klucel HA	Hydroxyalkylcellulose	Hercules
L-43 Silicone		Union Carbide
Laneto 50, 100	Polyethylene glycol-50 lanolin <i>PEG-50 Lanolin</i>	R.I.T.A.
Lanoquats	Quaternized fatty acid amides derived from lanolin acid	Malmstrom
Lanoquat DES	Lanolin quaternary	Malmstrom
Lantrol	Liquid lanolin <i>Lanolin oil</i>	Malmstrom
Laponite	Hectorite-type synthetic clay	Laporte
Lathanol LAL	<i>Sodium Lauryl Sulphoacetate</i>	Stepan
Lexate TA	Glyceryl stearate, isopropyl myristate and stearyl stearate	Inolex
Lexein X-250	Hydrolysed animal protein	Inolex

Proprietary name	Chemical description	Supplier
Lexemul AR	Glycerol sterate	Inolex
Lexemul AS	Glyceryl stearate and sodium lauryl sulphate	Inolex
Liquid Base CB. 3929	Mineral oil and lanolin alcohols	Croda
Loramine DU 185	Undecylenamide diethanolamide	Rewo
Loramine OM 101	Monoalkylolamide of mixed fatty acids	Rewo
Loramine SBU 185	Disodium monoundecylenamido monoethanolamide sulphosuccinate	Rewo
Loramine U 185	Undecylenamide monoethanolamide	Rewo
Luviset CE 5055	Vinyl acetate/crotonic acid copolymer	BASF
Marinol	Alkyldimethylbenzylammonium chloride	Berk
Maypon 4C	Potassium cocylhydrolysed animal protein	Stepan
Merquat-550	Polymeric quaternary ammonium salt consisting of acrylamide and dimethyldiallyl ammonium chloride monomers <i>Quaternium-41</i>	Merck
Merquat resins	Dialkyldimethyl ammonium chloride cyclopolymers	Merck
Methocel	<i>Hydroxypropylmethylcellulose</i>	Dow
Methofas	Methylcellulose	ICI
Microdry	Aluminium chlorhydrate fine powder <i>Aluminum Chlorohydrate</i>	Reheis
Miranol C2M, C2M-SF	A long-chain imidazoline type of zwitterion <i>Amphoteric-2</i>	Miranol
Miranol SM	Capryl imidazoline derivative	Miranol
Mirapol A15	Polyquaternary ammonium compound	Miranol
Modulan	<i>Acetylated Lanolin</i>	Amerchol
Morpan CHSA	Cetyltrimethylammonium bromide	Glovers
Myacide SP	2,4-Dichlorobenzyl alcohol	Boots
Myrj 45	Polyoxyethylene monostearate <i>PEG-8 Stearate</i>	ICI
Myrj 52	Polyoxyethylene monostearate <i>PEG-40 Stearate</i>	ICI
Myverol 18-17	Molecularly distilled monoglyceride	Eastman

Proprietary name	Chemical description	Supplier
Nacconal NRSF	Alkylaryl sulphonate	Allied Chemical
Natrosol	<i>Hydroxyethylcellulose</i>	Hercules
Neo-fat 18-55	<i>Stearic Acid</i>	Armak
Neo-PCL, water-soluble	Ethoxylated alkyl phenol and polyethylene glycol ester of 2-ethylhexanoic acid <i>Nonoxynol-14</i> and <i>PEG-4 Octanoate</i>	Dragoco
Neosyl	Finely divided silica	Crosfield
Neutronyx 600	Ethoxylated alkyl phenol <i>Nonoxynol-9</i>	Onyx
Nimlesterol D	<i>Mineral Oil</i> and <i>Lanolin Alcohol</i>	Malmstrom
Ninol 2012	Fatty acid alkanolamine concentrate	Stepan
Nipagin M	Methyl ester of <i>p</i> -hydroxybenzoic acid <i>Methylparaben</i>	Nipa
Nipagin P		Nipa
Nipasol M	Propyl- <i>p</i> -hydroxybenzoate <i>Propylparaben</i>	Nipa
Nonic 218	Polyethylene glycol <i>tert</i> -dodecyl thioether	Sharples Chem.
Novol	<i>Oleyl Alcohol</i>	Croda
Oat-Pro	<i>OatFlour</i>	Quaker Oats
Octaphen	<i>p-tert</i> -Octylphenoxyethoxyethyl dimethylbenzylammonium chloride	Ward Blenkinsop
Omadine	1-Hydroxypyridine-2-thione	Olin Mathieson
Omamids	Polyamide resins	Olin Mathieson
Onamer	Poly(dimethylbutenylammonium chloride)- $\alpha$ , $\omega$ -bis(triethanolamine chloride)	Onyx
Oracid	Urea-formaldehyde foam	Chemische Fabrik Frankenthal
Orvus WA	<i>Sodium Lauryl Sulfate</i>	Procter & Gamble
Ottasept extra	<i>Chloroxyleneol</i>	Ottawa Chemical
PCL Liquid	<i>Cetearyl Octanoate</i>	Dragoco
Phemerol	<i>p-tert</i> -Octylphenoxyethoxyethyl dimethylbenzylammonium chloride	Parke-Davis
Phenonip	Combination of parabens and phenoxyethanol	Nipa
Pluronic F-127	A polyoxyethylene- polyoxypropylene block polymer <i>Poloxamer-407</i>	BASF-Wyandotte

Proprietary name	Chemical description	Supplier
Pluronic L64D	A polyoxyethylene–polyoxypropylene block polymer <i>Poloxamer-184</i>	BASF-Wyandotte
Polawax	Nonionic emulsifying wax	Croda
Polawax A.31	Blend of cetyl stearyl alcohol and EO condensate products	Croda
Polychol 5	Polyethylene glycol condensate of wool wax alcohols <i>Laneth-5</i>	Croda
Polychol 15	Polyethylene glycol ester of lanolin alcohol with an average ethoxylation value of 15 <i>Laneth-15</i>	Croda
Polyglycol 400	Polyethylene glycol 400	Hoechst
Polymer JR	Cationic cellulose ether derivative <i>Quaternium-19</i>	Union Carbide
Povidone-Iodine	<i>PVP-iodine</i>	Berk
Procetyl AWS	Polyoxypropylene, polyoxyethylene ether of cetyl alcohol <i>PPG-5-Ceteth-20</i>	Croda
Promulgen D	Cetylstearyl alcohol and its polyethoxylated (20) derivative <i>Cetearyl Alcohol</i> and <i>Ceteareth-20</i>	Robinson-Wagner
Prosolal S8	Octyl cinnamate sunscreen	Dragoco
Prosolal 58	Mixture of phenylacrylic esters and oxybenzoic acid esters	Dragoco
Protolate WS	PEG-75-lanolin and hydrolysed animal protein <i>PEG-75 Lanolin oil</i>	Malmstrom
PVP-VA E-735	<i>PVP/VA Copolymer</i>	GAF
Quadramer		American Cyanamid
Renex	Polyoxyethylene esters of mixed resin and fatty acids	ICI
Resyn 28-1310	<i>Vinyl Acetate/Crotonic Acid Copolymer</i>	National Starch
Resyn 28-2930	<i>Vinyl Acetate/Crotonic Acid/Vinyl Neodecanoate Polymer</i>	National Starch
Rewopol SBFA 30	Disodium lauryl alcohol polyglycol ether sulphosuccinate	Rewo
Roccal	Alkyldimethylbenzylammonium chloride <i>Benzalkonium Chloride</i>	Bayer

Proprietary name	Chemical description	Supplier
Sandopan DTC acid	$\alpha$ -(Carboxymethyl)- $\omega$ -(tridecyloxy) poly (oxy-1,2-ethanediyl) <i>Trideceth-7-Carboxylic Acid</i>	Sandoz
Sandopan TFL	Sulphoamidobetaine <i>Amphoteric-7</i>	Sandoz
Santicizer 8	Sulphonamide plasticizer	Monsanto
Santicizer 160	<i>Butyl Benzyl Phthalate</i>	Monsanto
Santocel 54	Hydrated silica	Monsanto
Santolite MHP	Toluenesulphonamide/formaldehyde resin	Monsanto
Santolite MS 80%	Toluenesulphonamide/formaldehyde resin	Monsanto
Schercoquat	Quaternized fatty acid amides derived from isostearic acid	Scher Chemicals
Silicone fluid DC-556	Polyphenylmethyl siloxane <i>Phenyl Dimethicone</i>	Dow Corning
Silicone fluid L-45	Dimethyl silicone <i>Dimethicone</i>	Union Carbide
Sodium silicate 'O'	<i>Sodium Silicate</i>	Philadelphia Quartz
Softigen 767	Ethoxylated partial glyceride fatty acid ester <i>PEG-6 Caprylic/Capric Glycerides</i>	Dynamit-Nobel
Solprotex	Digalloyl trioleate	Firmenich
Solulan 98	Acetylated polyoxyethylene (10) lanolin alcohol <i>Laneth-10 Acetate</i>	Amerchol
Sorbo	<i>Sorbitol</i>	ICI
Span 20	Sorbitan monolaurate <i>Sorbitan Laurate</i>	ICI
Span 60	Sorbitan monostearate <i>Sorbitan Stearate</i>	ICI
Span 80	Sorbitan monooleate <i>Sorbitan Oleate</i>	ICI
Span 85	<i>Sorbitan Trioleate</i>	ICI
Standapol OLP	Oleyl betaine	Henkel
Steinapon AM-B13	Alkylamido betaine	Goldschmidt
Stepanhold R-1	<i>PVP/Ethyl Methacrylate/Methacrylic Acid Polymer</i>	Stepan Chemical
Sunscreen 3573	Oil-soluble sunscreen	Merck
Surfynol 82	<i>Dimethyl Octynediol</i>	Air Products
Syloid 72	<i>Hydrated Silica</i>	Grace
Syncrowax ERLC	<i>C18-C36 Acid Glycol Esters</i>	Croda
Syncrowax HGLC	<i>C18-C36 Acid Triglyceride</i>	Croda

*Proprietary Materials*

911

<b>Proprietary name</b>	<b>Chemical description</b>	<b>Supplier</b>
Syncrowax HRC	<i>Glyceryl Tribehenate</i>	Croda
Syncrowax PRLC	Propylene glycol ester of mixed fatty/wax acids	Croda
TBS	3,4',5-Tribromosalicylanilide	Theodore St. Just
TCC	3,4,4'-Trichlorocarbanilide <i>Triclocarban</i>	Monsanto
TCS	2,3,3', 5-Tetrachlorosalicylanilide	Ciba-Geigy
Tegin 515	Glyceryl monostearate <i>Glyceryl Stearate</i>	Goldschmidt
Tego 103S		Goldschmidt
Tegobetaine L7	Cocamidopropyl betaine	Goldschmidt
Temasept IV	3,4', 5-Tribromosalicylanilide	Fine Organics
Tergitol NPX	Alkylaryl polyethylene glycol ether <i>Nonoxynol-10</i>	Union Carbide
Texapon Extract N25	Sodium lauryl ether sulphate <i>Sodium Laureth Sulfate</i>	Henkel
Timica	Mica coated with titanium dioxide	Mearl
Tinuvin P	UV-absorber	Ciba-Geigy
Tiona G	Titanium dioxide, oil-dispersible	Laporte
Topanol O	Butylated hydroxytoluene, i.e. 2,6-di- <i>tert</i> -butyl-4-methylphenol <i>BHT</i>	ICI
Topanol OC	Purified grade of Topanol O	ICI
Triton X-100	Alkylated aryl polyether alcohol <i>Octoxynol-9</i>	Rohm and Haas
Triton X-200	Sodium salt of alkylated aryl polyether sulphate <i>Sodium Octoxynol-3 Sulfonate</i>	Rohm and Haas
Triton X-400	Stearyldimethylbenzylammonium chloride <i>Stearalkonium Chloride</i>	Rohm and Haas
Tuasal 100	3,4', 5-Tribromosalicylanilide	Dow
Tween 20	Polyoxyethylene sorbitan monolaurate <i>Polysorbate-20</i>	ICI
Tween 40	Polyoxyethylene sorbitan monopalmitate <i>Polysorbate-40</i>	ICI
Tween 60	Polyoxyethylene sorbitan monostearate <i>Polysorbate-60</i>	ICI
Tween 65	Polyoxyethylene sorbitan tristearate <i>Polysorbate-65</i>	ICI

<b>Proprietary name</b>	<b>Chemical description</b>	<b>Supplier</b>
Tween 80	Polyoxyethylene sorbitan monooleate <i>Polysorbate-80</i>	ICI
Tylose	Sodium carboxymethylcellulose	Hoechst
Ucon LB-1715	Polypropylene glycol butyl ether <i>PPG-40 Butyl Ether</i>	Union Carbide
Ucon 50-HB-660	Polyoxypropylene, polyoxyethylene monobutyl ether <i>PPG-12-Buteth-16</i>	Union Carbide
Ultrawet 60L	Triethanolamine salt of alkylaryl sulphonate <i>TEA-Dodecylbenzene Sulfonate</i>	ARCO
Uvinul D-50	2,2',4,4'-Tetrahydroxybenzophenone <i>Benzophenone-2</i>	GAF
Uvistat	2-Hydroxy-4-methoxy-4'-methyl benzophenone	Ward Blenkinsop
Vancide 89RE	N-Trichloromethylthio-4-cyclohexene-1,2-dicarboximide <i>Captan</i>	Vanderbilt
Vancide BL	2,2'-Thiobis-(4,6-dichlorophenol)	Vanderbilt
Vantoc AL	Alkyltrimethylammonium bromide	ICI
Vantoc B	Tetradecylpyridinium bromide	ICI
Vantoc CL	Alkyldimethylbenzylammonium chloride	ICI
Veegum	<i>Magnesium Aluminum Silicate</i>	Vanderbilt
Veegum HV	<i>Magnesium Aluminum Silicate</i>	Vanderbilt
Veegum K	<i>Magnesium Aluminum Silicate</i>	Vanderbilt
VEM resin	<i>PVP/Ethyl Methacrylate/Methacrylic Acid Polymer</i>	Barr-Stalfort
Versamids	Polyamide resins	General Mills
Versene	Ethylenediamine tetraacetic acid <i>EDTA</i>	Dow
Virac	Iodophor (i.e. mixture of iodine with surface-active agent)	Ruson Laboratories
Volatile Silicone 7158, 7207	Cyclic dimethyl polysiloxane compound <i>Cyclomethicone</i>	Union Carbide
Volpo N3	Oleyl alcohol/ethylene oxide condensate	Croda
Volpo N5	Polyoxyethylene oleyl ether	Croda

*Proprietary Materials*

913

<b>Proprietary name</b>	<b>Chemical description</b>	<b>Supplier</b>
Volpo S10	Polyoxyethylene (10) stearyl ether <i>Steareth-10</i>	Croda
Volpo S20	Polyoxyethylene (20) stearyl ether <i>Steareth-20</i>	Croda
Wescodyne	Iodophor (i.e. mixture of iodine with surface-active agent)	Bebgue
Zephiran	Alkyldimethylbenzylammonium chloride	Bayer
Zephirol	Alkyldimethylbenzylammonium chloride	Bayer
Zetesol 856T 78-4329 (now named Celquat)	Alkyl ether sulphate Cationic polymer grafted on a cellulosic chain	Zschimmer & Schwarz National Starch





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# Index

- Abrasive action of toothpastes 619
- Abrasives in toothpastes 609
- Absorbency of face powders 289
- Absorption of radiation by sunscreens 242, 250
- Acacia gum in face masks 278
- Acetals as insect repellants 212
- Acetates as astringents 74
- Acetic acid as astringent 75
- Acetone as nail lacquer remover 386
- Acetone sodium metabisulphite as antioxidant 718
- Acetophenones in sunscreens 233, 235, 237
- Acetylcholine 13
- Acid dyes 526
- Acid theory of dental decay 596
- Acids, dissociation constants 689
- Acids, weak, as preservatives 687, 689
- Acne 17, 46, 119
  - incidence 119
  - products 121
- Acquired pellicle 590, 591
- Acrylic resins
  - in nail elongators 389
  - in nail lacquers 377, 384
- Acyl lactylates in shampoos 437
- Acyl peptides 637
  - in shampoos 437
- Acylamino acids 637
- Acylaminopropionates 637
- Acylsarcosinates in shampoos 436
- Adamantane chloride, chloroalkyltriazonia-, as preservative 687
- Adhesion of face powder 293
- Adipates in moisturizing creams 65
- Adrenalin 13
- Adrenocorticotrophic hormone 47
- Adsorption, role in surface activity 632
- Aerosol products
  - antiperspirants 134, 826, 831
  - coloured setting lotion 528
  - deo-colognes 833
  - deodorants 140, 824
  - depilatories 149, 840
  - foams 824, 828
  - foot powders 197
  - hair creams 825
  - hair sprays 474, 824, 831, 832
  - hairdressings 490, 824
  - hand creams 825
  - men's hairdressings 483
  - mouth fresheners 629
  - powder sprays 827
  - shampoos 454, 830
  - shaving foams 161, 829, 840
  - sun products 255, 825
  - toothpaste 825
- Aerosols, corrosion 833
  - storage testing 838
- Aesculin in sunscreens 256
- Affinity, molecular 729, 734
- After-bath products 108
- After shave products
  - crackling foam 185
  - cream and balm 186
  - foam 184
  - gel 185
  - lotions 75, 77, 181
  - powder 187
- Aggregation in emulsions 732
- Air Spun process for face powders 300
- Alanine derivatives as insect repellants 212
- Albumin in moisturizing creams 63
- Alcohols
  - as astringents 75, 76
  - as preservatives 687, 688, 691
  - fatty, in lipsticks 319
  - for disinfection of plant 886
- Aldehydes
  - oxidation 713
  - in rancid fats 720
- Alkali preparations for hair straightening 581
- Alkaline agents in hair waving 556, 568
- Alkanolamide sulphates 634
- Alkanolamides 636
  - as opacifiers in shampoos 446
  - as thickeners in shampoos 446
  - fatty acid, in shampoos 437
  - in foam baths 95
- Alkanolamine lauryl sulphates in shampoos 434
- Alkyl aryl polyglycol ethers 636
- Alkyl aryl sulphonates 634
- Alkyl benzene sulphonates
  - in foam baths 93, 94
  - in shampoos 433
- Alkyl ether carboxylates 634
- Alkyl ether sulphates 634
  - in shampoos 435
- Alkyl imidazolines 637
- Alkyl imidazolium salts 635
- Alkyl morpholinium salts 635
- Alkyl phosphates 634
- Alkyl polyethylene glycol sulphates in shampoos 435
- Alkyl polyethyleneimine 636
- Alkyl polyglycol ethers 636
- Alkyl propionates 637
- Alkyl pyridinium salts 635
- Alkyl sulphates 634
  - in shampoos 433
- Alkyl sulphonates 634
- Alkylamino acids 637
- Alkyldimethylbenzylammonium chloride in baby products 112
- Alkyldimethylbenzylammonium salts 635
- Alkyltrimethylammonium salts 635
- Alginates
  - in protective creams 83, 85
  - in rouge 340
- Alginic acid, triethanolamine salt, in shampoos 445
- Allantoin
  - in hand creams 69
  - in skin tonics 76, 77
  - in sunscreens 243
- Allergens 33, 39
- Allergic contact urticaria 37
- Allergy 33
- Alloxan for skin colouring 333
- All-purpose skin creams 51, 70
- Almond oil
  - in hair conditioners 508
  - in hairdressings 484
- Alopecia
  - androgenetica 402, 416
  - areata 416, 417
  - diffuse 46, 418
  - male pattern 15, 402, 416, 418

- Alopecia (*cont.*)  
   post-febrile 417  
   post-partum 416, 417  
 Alpha olefin sulphonates  
   in foam baths 94  
   in shampoos 433  
*Alternaria solani* 701  
 Alumina in protective creams 83  
 Alumina, hydrated, in toothpastes 611  
 Aluminium  
   cans for aerosols 801  
   corrosion 835, 853  
   foil in laminates 854  
   metal in eye cosmetics 342, 347  
   powder, contamination 893  
   soaps, in shampoos 445  
   tubes for packaging 853  
 Aluminium bromohydrate as antiperspirant 129  
 Aluminium chlorhydrate  
   as antiperspirant 127, 128, 129, 134, 136, 137, 138  
   as astringent 74  
 Aluminium chloride as antiperspirant 126, 127, 129, 131  
 Aluminium lactate in face masks 282  
 Aluminium oxide in setting lotions 473  
 Aluminium salts  
   as astringents 74, 75  
   in toothpastes 604  
 Aluminium silicate in baby powder 113  
 Aluminium stearate in mascara 346  
 Aluminium sulphate  
   as antiperspirant 129  
   in nail strengtheners 373  
 Aluminium zirconium chlorhydrate as antiperspirant 129, 137  
 Alums  
   as astringents 74, 76  
   in mouthwashes 628  
   in nail strengtheners 373  
 Amidoamine oxides in shampoos 446  
 Amine fluorides in toothpastes 603  
 Amine oxides  
   in foam baths 95  
   in hair conditioners 516  
   in shampoos 440  
 Amines in antioxidants 724  
 Amino acids  
   effect on hair growth 403  
   in hair keratin 403, 412  
   in hair tonics 504  
   in moisturizing creams 63  
   in skin 43  
 Amino acids, N-alkyl, in shampoos 440  
 Aminoalkanethiol derivatives in shampoos 446  
 Aminoanthraquinone dyes 530  
 Aminobenzaldehydes in sunscreens 235  
 Aminobenzenesulphonic acid in skin lighteners 272  
 Aminobenzoates in sunscreens 231, 232, 234, 235, 236, 238, 239, 243, 244  
 Aminobenzoic acid  
   in hair pigmentation 416  
   in sunscreens 232, 235, 243, 244, 256  
   phototoxicity 37  
 Aminoplastics in packaging 851  
 Aminopropionic acid esters as insect repellants 212  
 Ammoniated mercury for skin lightening 267  
 Ammonium lauryl ether sulphate in shampoos 435  
 Ammonium lauryl sulphate  
   in foam baths 93  
   in shampoos 434  
 Ammonium salts in toothpastes 601  
 Amniotic fluid in hair tonics 504  
 Amphipathic molecules 632  
 Ampholytic surfactants 633  
 Amphoteric surfactants  
   as germicides 668  
   in foam baths 95  
   in shampoos 440  
 Amyl acetate as nail lacquer remover 386  
 Anabesine sulphate as insect repellent 212  
 Anagen 14, 398  
 Anagen effluvium 416, 417  
 Anaphylactic sensitivity 36  
 Androgens  
   absorption by skin 45  
   in acne 18  
   in hair growth 15, 402  
   in sebaceous gland activity 16  
   in skin pigmentation 9  
 Animal oils in hairdressings 484  
 Anionic surfactants 633  
   as preservatives 693  
   effects on hair 427  
   in foam baths 93  
   in shampoos 432  
   interaction with preservatives 697  
 Anodizing of aluminium aerosol cans 838  
 Anonychia 365  
 Anthranilates in sunscreens 233, 236, 243, 244  
 Anthraquinone dyes 526, 527  
 Antiandrogens  
   in hair growth 15, 402, 418  
   in sebaceous gland activity 16, 18  
   in skin 46  
   in treatment of hair loss 502  
 Antibacterial agents  
   as deodorants 132  
   substantivity 658  
 Antibiotics  
   in acne products 123  
   in oral products 598  
 Antibodies 33, 34  
 Anticholinergic substances 12, 126  
 Antifungal agents for tinea pedis 204  
 Antigens 33  
 Antimony trisulphide in eye make-up 341  
 Antioxidants  
   in hair dyes 542  
   in shampoos 432, 446  
 Antiperspirant products  
   aerosols 134, 826, 831  
   creams 137  
   foot cream 199  
   foot powder 197  
   foot spray 197  
   OTC panel 128, 130  
   roll-ons 138  
   sticks 136  
 Antiperspirants  
   action 126  
   efficacy 130  
   evaluation 130  
   ingredient classification 128  
   purpose 124  
 Antiseptics in sunburn products 257  
 Anti-wrinkle products 282  
 Apatite, synthetic 610  
 Apricot oil in hairdressings 484  
 Apocrine glands 16, 125  
 Aquasol aerosol 843  
 Arachidonic acid in skin 44  
 Aragonite 610  
 Argillaceous face masks 280  
 Arnica in hair tonics 503  
 Arquad antibacterial agent 665  
 Arrector pili muscles 12, 165  
 Arsenical pyrites as depilatory agent 142  
 Aryl sulphonamide-formaldehyde resins  
   in nail lacquers 377  
   in nail mending compositions 391  
 Ascorbic acid  
   as antioxidant 718, 721, 724  
   deficiency 44  
   in skin creams 61  
   in skin lighteners 271, 272  
 Ascorbyl oleate in skin lighteners 272  
 Ascorbyl palmitate  
   as antioxidant 718, 721, 724  
   in skin lighteners 271  
*Aspergillus niger* 701  
 Astringents in face masks 281

- Athlete's foot 192  
   products 202  
 Atmospheric oxidation in hair waving 572  
 Atomizer spray 844  
 Attrition mills 300, 334  
 Autoxidation 707, 724  
 Avocado oil  
   in hair conditioners 508  
   in hairdressings 484  
 Azine dyes 527  
 Azo dyes 526, 527, 532  
 Azoles in sunscreens 233  
 Azulene in skin tonics 76
- Baby products**  
   creams 112, 114  
   lotions 113, 114  
   oils 113, 116  
   ointment 113, 116  
   powder 113, 116  
*Bacillus subtilis* 701  
**Bacteria**  
   role in dental caries 598  
   in shampoos 447  
   on the skin 675, 891  
**Bacteriostats**  
   in shaving foams 165  
   in toothpaste 600  
**Bag-in-the-can aerosols** 839  
**Baking soda in deodorants** 132  
**Baldness** 15, 418, 501  
**Ball mill** 780  
**Bamboo extract in moisturizing creams** 63  
**Bandrowski bases** 538  
**Barcroft manometer** 720  
**Barium sulphide as depilatory** 151  
**Basal lamina** 5  
**Bases in shaving creams** 163  
**Basic dyes** 526, 527  
**Bath products**  
   cubes 103  
   oils 103  
   salts 101, 193  
   satins 109  
   tablets 103  
**Beard hair** 156, 165  
   softening 156  
   softening cream 157  
**Beau's lines** 366  
**Beeswax**  
   in all-purpose creams 71  
   in baby products 113, 116  
   in cold creams 55  
   in depilatories 142  
   in eyebrow pencil 353  
   in eyeshadow 348, 349  
   in face powder 299  
   in hairdressings 485  
   in lip salves 331  
   in lipsticks 322, 323, 324, 325, 327  
   in mascara 343, 345, 346  
   in rouge 335, 336, 337, 338  
   in stick make-up 311  
**Bentonite**  
   contamination 893  
   in face masks 277, 280  
   in products for oily skin 121  
   in protective creams 83  
**Bentonite clays**  
   in nail lacquers 383  
   in nail lacquer removers 388  
**Benzalkonium chloride** 664, 665, 666, 678, 687, 691, 698, 699  
**Benzethonium chloride** 665, 666, 687  
   in baby products 112  
   in deodorants 132  
   in mouthwashes 628  
   in toothpaste 600
- Benzoates**  
   as antioxidants 722  
   as astringents 74  
**Benzocaine**  
   in depilatories 143  
   in sunburn products 258  
**Benzoic acid as preservative** 687, 688, 689  
**Benzophenones in sunscreens** 225, 243, 244, 256  
**Benzoyl peroxide in acne products** 121  
**Benzyl alcohol in shampoos** 445  
**Benzyl benzoate as insect repellent** 207, 208, 211  
**Bergamot oil**  
   as insect repellent 207  
   in Berlock dermatitis 224  
**Berlock dermatitis** 224  
**Betaines** 637  
   in shampoos 440, 441  
**Binding agents**  
   for compact face powders 302  
   for toothpastes 612  
**Biodegradation of surfactants** 639  
**Biodeterioration** 675  
**Biphenyldisulphonates, hydroxy-, in sunscreens** 233  
**Birch tar oil**  
   as insect repellent 207  
   in hair tonics 504  
**Bismuth oxychloride**  
   in eyeshadow 347  
   in lipsticks 320  
   in rouge 336  
**Bismuth subnitrate in face powder** 308  
**Bisphenols** 659, 672  
**Bisulphite in hair straightening** 585  
**Bithionol** 657, 659, 660, 661, 672  
   phototoxicity 37  
**Black skin, depilation** 150  
**Blackheads** 18, 119  
**Bleaches**  
   for hair 547  
   in face masks 281  
   in toothpaste 615  
**Blood vessels of skin** 12  
**Bloom of face powders** 294  
**Blooming bath oils** 106  
**Blow waves** 474  
**Blusher** 334  
**Body odour** 124  
**Body powders** 108  
**Body talcs** 108  
**Boiling points of propellants** 809, 812  
**Borates in baby powder** 113  
**Borax**  
   in bath salts 102  
   in cold creams 55  
   in hair waving 555, 568  
**Boric acid**  
   as preservative 687, 689  
   in baby powder 113  
**Bovine growth hormone** 16  
**Bovine serum albumin in anti-wrinkle products** 282  
**Bradosol** 665  
**Bradykinin in inflammation** 31  
**Brassicidic acid in hair tonics** 503  
*Brevibacterium ammoniagenes* in nappy rash 112  
**Brilliantines** 484  
**Bromo acid dyes in lipsticks** 315  
**Bronopol** 668, 690  
**Bronze powder in eye shadow** 347  
**Brushite** 592  
**Brushless shaving cream** 171  
**Brushless shaving stick** 173  
**Bubble bath** 92  
**Buccal epithelial test** 626  
**Buildings, cleanliness** 878  
**Bunions** 191  
**Butane as propellant** 479, 811  
**Butanediol, interaction with preservatives** 695  
**Butoxypropyleneglycol as insect repellent** 211  
**Butoxypranoxyl as insect repellent** 207, 209, 213  
**Butyl acetate as nail lacquer remover** 387, 388

- Butylated hydroxyanisole as antioxidant 713, 720, 721, 724  
 Butylated hydroxytoluene as antioxidant 718, 720, 721, 724  
 Butylene glycol as humectant 644  
 Butylethylpropanediol as insect repellent 207, 211  
  
 Cactus extract in moisturizing creams 63  
 Cade tar oil in hair tonics 504  
 Cadmium sulphide as antidandruff agent 421  
 Cake make-up 304, 306  
 Calamine in sunburn products 257  
 Calciferol in skin creams 61  
 Calcite 610  
 Calcium carbonate  
   in baby powder 113, 117  
   in face powders 291  
   in sunscreens 232  
   in toothpaste 610  
 Calcium chloride as humectant 642  
 Calcium hydroxide in hairdressings 491  
 Calcium phosphates in toothpaste 610  
 Calcium pyrophosphate 610  
 Calcium stearate in shampoos 446  
 Calcium thioglycollate as depilatory 147, 151, 153  
 Calculus, dental 590, 592, 600  
 Calluses 191, 200  
 Camphor  
   as insect repellent 206  
   in astringents 76, 78  
   in depilatories 143  
   in hair tonics 503  
 Camphor derivatives in sunscreens 243, 244  
 Cancer of skin 224  
 Candelilla wax  
   in eyebrow pencil 353  
   in eyeshadow 349  
   in lipsticks 321, 324, 325, 326, 327  
   in rouge 338  
*Candida albicans* 701  
   in the mouth 626  
   in nappy rash 112  
*Candida parapsilosis* in products 679  
 Cantharides tinctures as hair tonics 503  
 Cantharidin in hair tonics 503  
 Caprylates in athlete's foot products 203  
 Capsaicin in hair tonics 503  
 Capsicum tinctures in hair tonics 503  
 Captan 669  
 Carbanilides 657, 662, 663  
 Carbohydrates, effect on skin 42  
 Carbon black in mascara 343, 344  
 Carbon dioxide as propellant 479, 814, 815, 832, 833  
 Carboxymethylcellulose 613  
 Carboxymethylmercaptosuccinic acid, esters of, as antioxidants 725  
 Carboxyvinyl polymers  
   in hairdressings 490  
   in shampoos 446  
 Carcinogenicity 522  
 Caries, dental 593, 594  
 Carmine  
   for skin colouring 333  
   in eye cosmetics 342  
 Carnauba wax  
   in eyebrow pencil 353  
   in eyeshadow 350  
   in hairdressings 485  
   in lipsticks 321, 323, 324, 325, 326, 327  
   in mascara 343, 345, 346  
   in rouge 336, 337, 338  
   in stick make-up 311  
 Carotene in skin 264  
 Carrageen gum 612  
   in face masks 278, 281  
 Carthamine for skin colouring 333  
 Casein in face masks 278  
 Casein hydrolysate in hair conditioners 507  
 Cassia oil as insect repellent 207  
  
 Castor oil  
   in baby products 113  
   in eyebrow pencil 352  
   in eyeshadow 350  
   in hair conditioners 508  
   in hairdressings 487  
   in lipsticks 319, 324, 325, 326, 327, 330  
   in mascara 347  
   in rouge 338, 341  
 Catagen 14, 398  
 Catechol in skin lighteners 272  
 Cationic antibacterials 664  
 Cationic polymers  
   in hair conditioners 507  
   in hair rinses 517  
   in hair thickeners 512  
   in protective creams 86  
   in setting lotions 473  
   in shampoos 444  
   in skin tonics 76  
 Cationic surfactants 633  
   as antidandruff agents 421  
   as preservatives 690, 692  
   in hair conditioners 506  
   in hair rinses 513  
   in hairdressings 484  
   in hand creams 69, 70  
   in moisturizing creams 63  
   in shampoos 442  
 Cedar tar oil in hair tonics 504  
 Cedarleaf oil as insect repellent 207  
 Cedrus atlantica oil as insect repellent 207  
 Ceepryn 665, 666  
 Cell-mediated response 33, 34  
 Cellulose acetate  
   in nail elongators 389  
   in laminates 854  
 Cellulose derivatives  
   in protective creams 83  
   in shampoos 443, 446  
   in toothpaste 613  
   interaction with preservatives 697  
 Cellulose ethers in toothpastes 613  
 Cellulose, microcrystalline  
   in antiperspirant sticks 137  
   in face powders 290  
 Cellulose nitrate in nail lacquers 376  
 Ceresin wax  
   in eyeshadow 350  
   in hairdressings 485  
   in lip salves 331  
   in lipsticks 323  
 Cervical erosion 619  
 Cetavlon 665  
   as antidandruff agent 421  
 Cetomacrogol, interaction with preservatives 694  
 Cetrimide 654, 664, 665, 666  
   as preservative 690  
 Cetyl alcohol in eyebrow pencil 353  
   in shampoos 446  
 Cetylpyridinium chloride  
   as preservative 687, 691, 694, 698  
   in baby products 112  
 Cetyltrimethylammonium bromide 665  
   as preservative 687  
   in baby products 112  
 Chalcones in skin 47  
 Chalk  
   contamination 682  
   in cosmetic stockings 309  
   in face powders 286, 291, 297, 298, 299, 303, 306, 308  
   in liquid make-up 310  
   in rouge 334  
   in toothpaste 610  
 Chamomile hair dyes 546  
 Chelating agents, role in oxidation 717, 725  
 Chemical disinfection of plant 885  
 Chilblain products 201  
 China clay in face masks 280  
 Chloramine T 670

- Chloramines for plant disinfection 887  
 Chlorbutanol as preservative 687  
 Chlorhexidine 654, 658, 664, 666, 667, 670  
   as preservative 691, 699  
   in deodorants 132  
   in mouthwashes 628  
   in toothpaste 593, 600, 604, 614  
 Chlorhydroxides as astringents 74  
 Chlorides as astringents 74  
 Chlorinated phenols  
   in mouthwashes 627  
   in shampoos 458  
 Chlorine dioxide, effect on hair 412  
 Chlorine for disinfection of plant 887  
 Chlorobenzoic acid as preservative 687, 689  
 Chlorobutadiene as depilatory 151  
 Chlorocresol 659, 660  
 Chlorodiethylbenzamide as insect repellent 207  
 Chlorofluorocarbon propellants 809, 815  
   effect on ozone layer 474, 810  
 Chlorophenols as antidandruff agents 499  
 Chlorophyll in toothpaste 600  
 Chloroquine, effect on nails 367  
 Chloroxyleneol 654, 658, 659  
 Cholesterol derivatives in hair rinses 517  
 Cholesterol in hairdressings 492  
 Cholic acid in hair tonics 504  
 Chromium oxide in eye cosmetics 342, 349, 351  
 Chromium salts as astringents 74  
 Cinnabar for skin colouring 333  
 Cinnamates in sunscreens 234, 235, 236, 243, 244  
 Cinnamic acid derivatives in sunscreens 253  
 Citrate esters in aerosol antiperspirants 135  
 Citrates as astringents 74  
 Citric acid  
   as astringent 75, 77, 78  
   role in oxidation 717, 718, 721, 722, 723  
 Citronella oil as insect repellent 207  
 Citronellol in hair tonics 503  
*Cladosporium resinae* in products 678  
 Clarifying agents in shampoos 446  
 Clays in protective creams 83  
 Cleaning of manufacturing plant 880, 881, 888  
 Cleansing creams 53  
 Clinical trials for toothpastes 602, 603  
 Cloflucarban in deodorant soaps 139  
 Closures for packages 860  
 Clove oil as insect repellent 206  
 CMC 633  
 Coal tar 654  
   as antidandruff agent 499  
 Cobalt salts in eye cosmetics 342  
 Cochineal for skin colouring 333  
 Cocoa butter  
   in eyebrow pencil 352  
   in eyeshadow 348  
   in lipsticks 322, 323  
   in mascara 346  
   in rouge 338  
 Coconut oil in hairdressings 485  
 Co-dispensing aerosol valves 840, 841  
 Cold creams 51, 55  
 Collagen 10  
 Collagen hydrolysate in hair conditioners 507  
 Colloid mill 778  
 Colognes 75  
 Colour lightening 534  
 Colours  
   for bath salts 102  
   for eye cosmetics 342  
   for face powders 295  
   for foam baths 97  
   for lipsticks 315, 328  
   for nail lacquers 381  
   for rouge 335  
   for shampoos 432  
   for shaving foams 164  
   for toothpastes 615  
 Combing, ease of 430, 431  
 Comedones 18, 119  
 Compact face powder 301  
 Complement 29, 31  
 Conditioning agents  
   in hair dyes 544  
   in shampoos 431, 443  
 Contact urticaria 31  
 Contamination  
   clinical significance 678  
   of products by bacteria 677  
 Cooling agents in shaving foams 164  
 Copper  
   in formation of melanin 415  
   in greying of hair 416  
 Copper salts as astringents 74  
 Corn preparations 200  
 Corns 191  
 Corrosion  
   by humectants 642  
   of aerosol cans 835  
   of aluminium 835, 853  
 Corrosion inhibitors  
   in shaving foams 165  
   in toothpastes 615  
 Corticosteroids  
   absorption by skin 45  
   in dermatology 47  
   in treatment of vitiligo 17  
 Cortisone in dermatology 47  
*Corynebacterium acnes* 18, 120  
 Cottonseed oil in eyebrow pencil 352  
 Coulter counter 301  
 Coumarin derivatives in sunscreens 233, 235, 247  
 Covering power of face powders 285  
 Crackling foam 185  
 Crayons for hair colouring 528  
 Cream, definition 50  
 Creams, *see* After-shave, All-purpose, Antiperspirant, Baby, Beard-softening, Cleansing, Cold, Foot, Foundation, Hand, Hand and body, Insect repellent, Make-up, Massage, Moisturizing, Nail, Night, Nutritive, Protective, Shaving, Sports, Vanishing  
 Cresols  
   as antiseptics 659  
   as preservatives 687, 691  
 Critical Micelle Concentration 633  
 Curlers, heated 473  
 Cuticle of the nail 363  
   removers 369  
   softeners 370  
 Cyanurates in nail bleaches 371  
 Cyclohexylacetate as insect repellent 207  
 Cyproterone acetate  
   in hair growth 419  
   in sebaceous gland activity 16, 18  
   in skin 46  
 Cysteine in shampoos 446  
 Cysteine hydrochloride as antioxidant 718  
 Damage to hair by waving solutions 575  
 Dandruff 19, 419, 498  
 Decenoic acid as insect repellent 206  
 Decyl alcohol as insect repellent 212  
 Dehydroacetic acid as preservative 687, 689, 699, 700  
 Delayed hypersensitivity 34, 39  
 Demineralization of enamel 595  
 Density of toothpaste 617  
 Dental calculus 590, 592, 600  
 Dental caries 593, 594  
 Dental plaque 590, 591  
 Dentifrice, solid 618  
 Dentine 589  
 Denture cleansers 622  
 Deo-colognes, aerosol 833  
 Deodorant products foot cream 198  
   foot spray 198  
   soaps 139  
   sticks 139  
 Deodorants,  
   action 132

- Deodorants (*cont.*)  
 assessment 133  
 purpose 124  
 Dermatan sulphate 11  
 Dermis 10  
 Dermo-epidermal junction 5, 13  
 Desmosomes 5, 6  
 Detergency 429, 637  
 Detergents  
 evaluation as shampoo bases 429  
 for cleaning plant 883  
 for shampoos 432  
 in toothpaste 611  
 Dexamethasone in skin lighteners 270  
 Dialkyl adipates in hairdressings 484  
 Dialkyl sebacates in hairdressings 484  
 Dialkyl sulphosuccinates 634  
 Dialkyldimethylammonium salts 635  
 Diaper rash 111  
 Diapers, cleansing 117  
 Dibenzalacetone in sunscreens 233  
 Dibromosalicylanilide 663  
 Dibutyl phthalate as insect repellent 207, 211  
 Dibutyl succinate as insect repellent 211  
 Dicalcium phosphate, anhydrous 610, 611  
 Dicalcium phosphate dihydrate 610  
 Dichlorophene 659, 661  
 as preservative 687, 691  
 Dicyanamide in depilatories 148  
 Diethylene glycol as humectant 647  
 Diethylthiourea in nail strengtheners 373  
 Diethyltoluamide as insect repellent 207, 208, 209, 210  
 Digalloyl trioleate  
 in sunscreens 243, 244, 247  
 phototoxicity 37  
 Diglycol stearate in rouge 339  
 Diguano-hexane, bischlorophenyl-, as preservative 687  
 Dihydrotestosterone  
 in hair growth 418  
 in skin 47  
 Dihydroxyacetone  
 in sunscreens 243  
 in suntan products 259, 260  
 Dihydroxynaphthoic acid in sunscreens 233  
 Dihydroxyphenylalanine in formation of melanin 9, 268, 413  
 Diisopropyl tartrate as insect repellent 207  
 Dilatency 769  
 Dilaurylthiodipropionates as antioxidants 721  
 Diluents in nail lacquers 380  
 Dimethyl carbate as insect repellent 207, 208  
 Dimethyl ether as propellant 479, 813, 831, 833  
 Dimethyl phthalate as insect repellent 207, 208  
 Dimethylol thiourea  
 for strengthening hair 575  
 in nail strengtheners 373  
 Dimethylol urea for strengthening hair 575  
 Dimethylsulphoxide, effect on skin penetration 45  
 Diometam 665  
 Dioxan, acetoxydimethyl-, as preservative 687  
 Dioxan, bromonitro-, as preservative 687  
 Dioxin 669  
 Diphenylamines in hair dyes 536  
 Diphosphonate in toothpastes 604  
 Diphtheroids in products 678, 679, 681  
 Dipropylene glycol as humectant 647  
 Disinfectants 653  
 Disinfection of manufacturing plant 880, 890  
 Dispenser pumps 844, 861  
 Disperse dyes 526, 527  
 Dispersible bath oils 406  
 Dissociation constants of acids used as preservatives 689  
 Distillation of water 869  
 Disulphide links  
 in hair 406  
 in keratin 406, 412  
 in weakened hair 575  
 Dodecyl alcohol as insect repellent 212  
 Domiphen bromide 665, 666  
 Dopa in formation of melanin 9, 268, 413  
 Dopa quinone in formation of melanin 9  
 Double layer in emulsions 742  
 Dough mixer 775  
 Dowicil 667  
 Draize test for shampoos 460  
 Drying of hair 430  
 Drying out of products 641  
 Drying time of shampoos 445  
 Dusting powders 108  
 Earth-based face masks 280  
 Eccrine sweat glands 10, 12, 13, 125  
 Eczema, infantile 112  
 EDTA in shampoos 447  
 Egg yolk in hair tonics 504  
 Elastic fluids 769  
 Elastin 11  
 Elastomer pressure sprayer 844  
 Electrical charge in emulsions 741  
 Electro-corrosivity 838  
 Electrolysis for depilation 144  
 Electrolytes in shampoos 446  
 Electrostatic charge in aerosols 827  
 Embden-Meyerhof pathway in skin cells 42  
 Emollience 65  
 Emollients  
 after-bath 109  
 in bath oils 106  
 in foam baths 96  
 in hand cleansers 89  
 Emulsification 638, 794  
 Emulsifying agents 734  
 Emulsions  
 analysis 754  
 appearance 750  
 application properties 754  
 as hairdressings 491  
 breakdown 731  
 coalescence 732  
 creaming 732  
 determination of type 754  
 electrical charge 741  
 manufacture 747  
 pH 744  
 quality control 754  
 rheological properties 752  
 stability 650, 731, 733, 738, 749  
 water loss 646, 650  
 Enamel, dental 588, 589  
 Endorsement of toothpastes 601  
 Enterobacter aerogenes 701  
 Enzyme inhibitors in toothpaste 600  
 Enzymes  
 as depilatories 150  
 in dental caries 596, 598  
 in denture cleansers 624  
 in hair dyes 543  
 in hair waving 561  
 in inflammation 29, 31  
 in toothpastes 601  
 Eosin  
 phototoxicity 37  
 in lipsticks 315  
 in rouge 333  
 solubility 320  
 Eosinophils in inflammation 31  
 Ephilides 17  
 Epidermis 5  
*Epidermophyton floccosum* in athlete's foot 192  
*Epidermophyton inguinale* in athlete's foot 192  
 Epilation 142  
 Epoxy resins  
 as aerosol can lacquers 837  
 as tube lacquers 853  
 Equipment  
 contamination 682  
 design for cleanliness 879  
 Erythema 30  
 caused by sunlight 222, 223, 225, 227  
 Erythemogenic radiation 222, 225

- Erythrose in suntan products 260  
*Escherichia coli* in products 679, 701  
 Essential fatty acids  
   in skin 44  
   in skin creams 61  
 Essential oils in deodorants 133  
 Esters  
   as plasticizers in setting lotions 472  
   in moisturizing creams 65  
   in vanishing creams 62  
 Ethanol  
   as astringent 75  
   in hair sprays 477  
 Ethoxylated alkyltrimethylammonium salts 635  
 Ethoxylated alkylphenols in shampoos 439  
 Ethoxylated fatty acid amides in shampoos 439  
 Ethoxylated fatty acid diesters in shampoos 446  
 Ethoxylated fatty acid esters in shampoos 439  
 Ethoxylated fatty alcohols in shampoos 439  
 Ethoxylated fatty amines in shampoos 439  
 Ethyl acetate as nail lacquer remover 386  
 Ethyl alcohol  
   as deodorant 133  
   interaction with preservatives 695  
 Ethyl hexanediol as insect repellent 207, 208  
 Ethylene glycol  
   as humectant 643, 645, 647, 651  
   in moisturizing creams 64  
 Ethylene oxide for disinfection of plant 885  
 Ethylenediamine tetraacetic acid  
   in oxidation 717, 721, 725  
   in shampoos 447  
 Ethylhexyl palmitate in sunscreens 251  
 Ethylhexyl salicylate in sunscreens 243, 244  
 Ethylhexylcyanodiphenyl acrylate in sunscreens 243  
 Ethylhexyl palmitate in sunscreens 251  
 Ethylhexyl salicylate in sunscreens 243, 244  
 Eucalyptus oil as insect repellent 207  
 Eumelanin 9, 265, 413  
   in skin 43  
 Evaporation rates of solvents 379  
 E-viton concept 227  
 Extinction coefficients of sunscreens 236  
 Extruder 776  
 Eye cosmetics, contamination 678  
 Eye irritation by surfactants 461  
 Eye make-up 341  
   application 358  
 Eyebrow pencil 352  
   application 358  
 Eyeliner 351  
   application 359  
 Eyeshadow 347  
   application 359  
   cream 348  
   liquid 351  
   stick 350  
 Face masks 78, 79  
 Fast-filling valves for aerosols 808  
 Fats,  
   contamination 681  
   oxidation 707, 719  
 Fatty acid alkanolamides in shampoos 437  
 Fatty acid amides in hairdressings 484  
 Fatty acid esters in hair conditioners 508  
 Fatty acid soaps 634  
 Fatty acids  
   in hair conditioners 508  
   in shaving creams 160  
   in shaving foams 162  
   oxidation 707, 713  
 Fatty alcohol ether sulphates in foam baths 93  
 Fatty alcohol lactates in hairdressings 484  
 Fatty alcohol sulphates in foam baths 93  
 Fatty alcohols  
   in hair conditioners 508  
   in hairdressings 484  
 Fennel oil as insect repellent 207  
 Fentichlor 662  
 Ferric fluoride in toothpaste 603  
 Ferulic acid in hair tonics 504  
 Fibroblasts 10, 11  
 Fibrocyte 11  
 Fillers in foam baths 99  
 Filling equipment, contamination 683  
 Film thickness of sunscreen products 245  
 Filtration of water 872  
 Finger pumps 844  
 Finsen unit of erythema flux 227  
 Fixanol 665  
 Flammability of aerosols 479, 481, 832  
 Flash points of hydrocarbon propellants 812  
 Flavours  
   for mouthwashes 628  
   for toothpastes 614  
 Floating bath oils 104  
 Flocculation 790  
   in emulsions 732  
 Floors, cleanliness 878  
 Fluid energy mill 766  
 Fluorapatite 602  
 Fluoride,  
   effect on dental enamel 598  
   in dentine and enamel 589  
   in tooth powder 618  
   in toothpaste 601, 616  
   in water supplies 589, 598  
 Fluorinated polymers  
   in hair sprays 477  
   in setting lotions 473  
   in shampoos 446  
 Fluorocarbon resins in hair conditioners 508  
 Fluorocarbons, effect on ozone layer 474, 810, 831  
 Fluorometholone in skin lighteners 271  
 Fluorophene 663  
 Fluorozirconates in toothpaste 604  
 Foam of shampoo 429  
 Foam baths 92  
   assessment 100  
   dry 99  
   foaming agents 93  
   gels 99  
   irritation 92, 93, 94, 99  
 Foam boosters  
   for foam baths 95  
   for shampoos 431  
 Foam stabilizers for shampoos 431  
 Foam valves for aerosols 806  
 Foaming 637  
 Foaming bath oils 107  
 Follicular keratosis 44  
 Food debris 593  
   in dental caries 597  
 Foot bath preparations 193  
 Foot products  
   creams 198  
   massage emulsion 200  
   powder 196  
   sprays 197  
 Footwear, influence on foot health 190  
 Formaldehyde  
   as antiperspirant 126  
   as preservative 687, 688, 701  
   for disinfection of plant 682, 885  
   for disinfection of water 870  
   in shampoos 447  
   in toothpastes 614  
   release during hair strengthening treatments 576  
 Formaldehyde resins in nail strengtheners 373  
 Formalin in toothpastes 614  
 Formates as astringents 74  
 Formic acid  
   as astringent 75  
   as preservative 687, 689  
 Foundation  
   application 357  
   creams 51, 62  
   pigmented 67  
 Freckles 17



- Free radicals in oxidation 709, 714, 716  
Friction during shaving 157  
Fruit extracts in moisturizing creams 63  
Fuller's earth in face masks 280  
Fungi  
  in products 677  
  in raw materials 681  
  on skin 675
- Gallates, alkyl, as antioxidants 718, 720, 721, 722  
Gallic acid as antioxidant 722, 723  
Galvanic action in corrosion 836  
Gamma-valerolactone as nail lacquer remover 387  
Gaskets for aerosol cans 804, 805  
Gel hairdressings 494  
Gelatin,  
  effect on nail growth 366  
  in face masks 278, 279  
  in moisturizing creams 63  
Gelling agents  
  in hairdressings 486, 494  
  in toothpastes 612  
Germall 670  
Germicides  
  as dandruff treatments 421  
  in baby products 112  
  in shaving foams 165  
  in skin products 120, 121  
Gingivitis 599  
Ginseng in hair tonics 504  
Glass containers for aerosols 802  
Glass in packaging 854  
Gleamer 336  
Glomerulae 13  
Gloss of teeth 620  
Gluconates as astringents 74  
Glucose  
  absorption by skin 45  
  as humectant 647  
  in skin 42  
Glutathione in shampoos 446  
Glycerides in hairdressings 484  
Glycerol  
  as humectant 612, 643  
  in antiwrinkle preparations 283  
  in face masks 278, 279, 280, 281  
  in hair sprays 477  
  in moisturizing creams 64, 65  
  inhibition of bacteria by 685  
  interaction with preservatives 695  
  metabolization 684, 697  
Glycerol palmitate in shampoos 446  
Glycerol stearate in shampoos 446  
Glyceryl ether sulphonates in shampoos 436  
Glyceryl monostearate  
  in face powder 299, 302, 306, 307  
  in liquid make-up 310  
Glycol stearates in shampoos 446  
Glycolates as astringents 74  
Glycols in hair sprays 477  
Glycolytic sequence in skin cells 42  
Glyoxylates in sunscreens 243, 244  
Godet 301  
Gold metal in eyeshadow 347  
Golgi-Mazzoni corpuscles 12  
Grease  
  reappearance on hair 446  
  removal from hair 427, 428  
Greasy hair 500  
Greying of hair 415  
Ground substance 11  
Guaiacum resin as antioxidant 721, 722, 724  
Guanidine in acne products 121  
Guanine  
  in nail lacquers 382  
  in sunscreens 244  
Guar gum in face masks 278  
Gum arabic  
  in mascara 344  
  in setting lotions 471
- Gum tragacanth  
  interaction with preservatives 695  
  in face masks 278, 279  
  in hairdressings 489  
  in mascara 347  
  in rouge 340  
  in setting lotions 471  
  in toothpastes 612
- Gums  
  contamination 681  
  degradation 684  
  interaction with preservatives 697
- Hair  
  chemistry 403, 411  
  colour 413  
  condition 427, 428, 438  
  cortex 396  
  cross-section 555, 581  
  cuticle 396  
  damage 413  
  density 397  
  disorders 416  
  extraction with solvents 428  
  follicle 10, 12, 13, 14, 396, 397, 398, 400  
  greying 415  
  growth cycle 398, 401  
  growth rate 400  
  hydration 156  
  lanugo 397  
  loss 416, 501  
  lustre 430  
  mechanical properties 564  
  medulla 396  
  mineral constituents 409  
  surface area 428, 526  
  terminal 398  
  vellus 398  
  yield point 562  
Hair colour rinses 528  
Hair dye removers 547  
Hair dyeing, mechanism 524  
Hair dyes  
  aromatic polyhydroxy 544  
  henna 545  
  oxidation 533  
  para 533  
  permanent 522, 533  
  semi-permanent 522, 528  
  staining of scalp 525  
  temporary 521, 526  
  uptake by scalp 525  
  vegetable 545  
Hair rinses 513  
Hair sprays 474  
  evaluation 480  
  for men 490  
  toxicity 481  
Hair thickeners 512  
Hair waving  
  chemical heating 569  
  chemistry 556  
  cold processes 569  
  evaluation 562  
  foam products 572  
  hot processes 567  
  warm air processes 574  
Hammer mills 300, 334, 762  
Hand and body creams 69  
Hand creams 51, 69  
  aerosol 825  
Handwashing test for antibacterials 657, 671  
Haptens 33  
Heat treatment of water 871  
Heated curlers 473  
Hectorite clays  
  contamination 893  
  in nail lacquers 383  
  in toothpaste 614

- Henna hair dyes 545  
 Herbal extracts in foam baths 97  
 Hexachlorophene 654  
   as dandruff treatment 421  
   as preservative 687, 691  
   in deodorants 132, 139  
   in mouthwashes 628  
   in toothpaste 600  
   phototoxicity 38  
 Hexadecyl alcohol  
   in lipsticks 319, 324  
   in mascara 345  
 Hexahydrophthalic acid, diethyl ester, as insect repellent 207  
 Hexamethylene tetramine  
   as preservative 690  
   in deodorants 132  
 Hexamethylenecarbamide as insect repellent 212  
 Hexamine as preservative 687  
 Hexokinase 638  
 Hexose-monophosphate shunt in skin cells 42  
 Hexylene glycol, interaction with preservatives 695  
 Hibitane 667  
   in toothpaste 600, 604  
 High shear mixer 776  
 Hirsutism 15, 46, 402, 418  
 Histamine 11, 13  
   in anaphylactic sensitivity 36  
   in inflammation 29, 31, 32  
 Histidine in skin 43  
 Histiocytes 10  
 HLB value 105, 737  
   determination 745  
   limitations 746  
 Holocrine glands 15  
 Homomenthyl salicylate in sunscreens 235, 243, 244  
 Honey in shampoos 445  
 Hormones  
   effect on hair growth 401  
   effect on sebum excretion 46  
   effect on skin 42, 45  
 Hot comb for hair straightening 581  
 Hot shaving foams 167, 840  
 Hotroom tests 130  
 Humectants  
   in cake make-up 305  
   in face masks 278  
   in moisturizing creams 63  
   in shaving creams 160  
   in shaving foams 164  
   in toothpastes 612  
 Humidity, controlled 643  
 Hyaluronic acid 11  
 Hyamine 665  
 Hydantoin, monomethyloldimethyl-, as preservative 687  
 Hydrocarbons  
   as propellants 479, 811, 815  
   in sunscreen products 233  
 Hydrocolloid-based face masks 278  
 Hydrogen bonds in keratin 404  
 Hydrogen peroxide  
   in hair bleach 547  
   in hair dyes 533  
   in mouthwashes 628  
   in nail bleaches 371  
   in toothpaste 615  
 Hydrolysed protein in moisturizing creams 63  
 Hydroperoxide in oxidation 709, 710, 721  
 Hydroquinone  
   as antioxidant 718, 724  
   in skin lightening 265, 267  
   in sunscreen products 233  
 Hydroquinone, butyl-, as antioxidant 721  
 Hydroquinone, monobenzyl ether, in skin lighteners 266, 271  
 Hydroquinone, monoethyl ether, in skin lighteners 265, 271  
 Hydroquinone, monomethyl ether, in skin lighteners 265, 271  
 Hydroxyapatite 588, 602  
 Hydroxybenzoates  
   as antioxidants 722  
   as preservatives 687, 688, 691, 698  
 Hydroxybenzoic acid as preservative 687, 689  
 Hydroxyethylcellulose 613  
 Hydroxyl values 717  
 Hydroxypropylcellulose in hairdressings 490  
 Hydroxyquinoline as preservative 687  
 Hydroxyquinoline, dichloro-, in shampoos 458  
 Hygroscopicity,  
   equilibrium, of humectants 644, 648  
   of products 64, 643  
 Hyperhidrosis 125  
   of the feet 193  
 Hyperkeratosis 30  
 Hyperpigmentation of skin 270  
 Hyperplasia 30  
 Hypersensitivity 33  
 Hypertrichosis lanuginosa 398  
 Hypochlorite  
   for plant disinfection 682, 887  
   for water disinfection 870  
   in nail bleaches 371  
 Ichthyocolla hydrolysate in hair conditioners 507  
 Imidazole sulphates 634  
 Imidazolidinyl urea as preservative 687, 691, 699  
 Imidazolines, alkyl- 637  
 Imidazolines in shampoos 440, 442  
 Immunoglobulins 34, 36  
 Immunological responses 33  
 Impedance of skin 128  
 Impetigo neonatorum 112  
 Inactivation of preservatives 692, 693  
 Indalone 207, 209  
 Indamine dyes 527  
 Indium fluorozirconate in toothpastes 604  
 Indium salts in toothpastes 604  
 Indoaniline dyes 527  
 Indole-5, 6-quinone in formation of melanin 6  
 Indophenol dyes 527  
 Infection of baby skin 111  
 Inflammation 11, 28  
 Inhalation toxicity of hair sprays 482  
 Innovair aerosol 842  
 Inoculation tests for preservatives 702  
 Inorganic fluorides in toothpastes 602  
 Insect repellent products  
   aerosol sprays 213  
   creams 215  
   gels 217  
   liquid creams 215  
   lotions 213  
   oils 214  
   pump sprays 214  
   sticks 218  
   towelettes 219  
 Insoluble sodium metaphosphate 611  
 Instant perms 575  
 Iodine as antiseptic 670  
 Iodine-containing sterilants for plant 887  
 Iodine values 717  
 Iodophors 654, 658, 670  
 Ion exchange for water purification 866  
 Ion exchange resins in foot products 204  
 Irgasan 654, 657, 659, 660, 661, 664  
 Irish moss 612  
 Iron  
   in hair 410, 413  
   in product deterioration 725  
 Iron oxides  
   in cosmetic stockings 310  
   in eyebrow pencil 352  
   in eyeshadow 351  
   in face powder 299, 305, 306  
   in liquid make-up 311  
   in mascara 342, 346, 349, 350  
   in nail lacquers 381  
   in rouge 335, 336  
   in stick make-up 311, 312

- Iron salts as astringents 74
- Irritation of baby skin 111
- Isethionates 634
  - in shampoos 436
- Isoascorbic acid as antioxidant 718
- Isopropanol
  - as astringent 75
  - in sunscreens 250
- Isopropyl myristate
  - in aerosol antiperspirants 134, 135
  - in bath oils 105, 106
  - in cuticle softeners 371
  - in eyeshadow 349
  - in foam baths 96
  - in hair sprays 476, 477
  - in hairdressings 486, 488
  - in mascara 346
  - in protective creams 84, 86
- Isopropyl palmitate in aerosol antiperspirants 135
- Isopropylcatechol in skin depigmentation 265, 272
- Isothan 665
- Ivory black in mascara 344
- Jaborandi tinctures as hair tonics 503
- Juglone in suntan products 260
- Kaolin,
  - contamination 682
  - in baby powder 113, 117
  - in face masks 278, 279, 280, 281
  - in face powders 289, 291, 292, 298, 299, 303, 306, 308
  - in liquid make-up 310
  - in mascara 346
  - in nail polishes 374
  - in nail white 373
  - in protective creams 83
  - in rouge 334, 335, 337
  - in stick make-up 312
  - in sunscreen products 232
  - interaction with preservatives 695
- Karaya gum
  - in setting lotions 471
  - in shampoos 446
- Keratin 403
  - affinity of hair dyes 523
  - disulphide links 406
  - hydrogen bonds 404
  - salt links 406
  - structure 407
- Keratin hydrolysate in hair conditioners 507
- Keratinase as depilatory 150
- Keratinization
  - of hair 14
  - of skin 5
- Keratinocytes 5, 6, 8, 10, 264, 265
- Keratohyalin 6
- Kerosene, deodorized
  - in hairdressings 484, 486
  - in hand cleansers 89, 90, 91
- Ketones, oxidation 714
- Kieselguhr in face powders 291
- Kinins 29
- Klebsiella pneumoniae* in hand creams 678
- Kohl for eye make-up 341
- Koilonychia 366
- Krause end bulbs 12
- Krebs cycle in skin cells 42
- Kreis test for rancidity 719
- Kritchewsky amides in shampoos 438
- Kwashiorkor 44, 402
- Lacquers
  - for aerosol cans 837
  - for collapsible tubes 853
- Lactalbumin in anti-wrinkle products 283
- Lactates
  - as astringents 74
  - in moisturizing creams 64
- Lactic acid as astringent 75, 77
- Lactoglobulin in anti-wrinkle products 283
- Lactylates, acyl-, in shampoos 437
- Lamina lucida 5
- Laminar flow 767
- Laminates
  - for collapsible tubes 853
  - for sachets 854
- Lampblack in mascara 343, 344, 345, 347
- Langerhans cells 5, 9
  - in allergy 34
- Lanolin
  - in all-purpose creams 71
  - in baby products 113, 115, 116
  - in cleansing creams 56, 58, 59
  - in eyebrow pencil 353
  - in eyeshadow 348, 349
  - in hand cleansers 89
  - in hand creams 70
  - in lipsticks 322, 323, 325, 327
  - in mascara 343, 344, 345
  - in massage and night creams 62
  - in moisturizing creams 63, 65
  - in protective creams 83, 86
  - in rouge 335, 336, 338
  - interaction with preservatives 695
- Lanolin absorption bases
  - in eyebrow pencil 352
  - in eyeshadow 349
  - in lipsticks 322
- Lanolin derivatives
  - in hair conditioners 508
  - in hair sprays 476
  - in hairdressings 484, 488
  - in setting lotions 472
  - in shampoos 445
- Lanthionine in hair waving 556, 558, 562
- Lanugo hair 397
- Lather of shampoo 429
- Laurel leaf oil as insect repellent 207
- Lauryl sulphates in shampoos 433, 438
- Lauryl sulphoacetates in foam baths 94
- Lavender oil as insect repellent 207
- Lawsonia
  - in sunscreen products 243
  - in suntan products 260
- Lead
  - in hair 410
  - in hair dyes 546
- Lead salts as astringents 74
- Lead tubes for packaging 852
- Leak testing of aerosols 821
- Lecithin
  - as antioxidant 718, 721, 722, 723, 724, 725
  - in hair conditioners 508
  - in hairdressings 484
  - in lipsticks 322
- Legislation
  - on antimicrobial agents 139, 654
  - on antioxidants 721
  - on antiperspirant ingredients 127
  - on chlorofluorocarbons 474
  - on colour additives 315, 381
  - on fluorides 616
  - on hair colorants 538
  - on methylene chloride 832
  - on preservatives 704
  - on skin lightening agents 267
  - on sunscreen ingredients 242
- Lemon juice in cleansing creams 58
- Lentigens 17
- Leucocytes 10
  - in inflammation 28
- Leukonychia 366
- Lighteners, hair 547
- Lime water in hairdressings 491
- Linear alkyl benzene sulphonates in foam baths 94, 100
- Linoleates in moisturizing creams 65
- Linoleic acid in skin 44
- Lip salves 330
- Lipids, ethoxylated, in moisturizing creams 65
- Lipids in skin 43, 64

- Lipoproteins in cell membranes 44
- Lipstick, application 360
- Liquid crystals in shaving creams 160
- Liquid face powders 307
- Liquid lipsticks 332
- Liquid make-up 310
- Lithium bromide, effect on hair 412, 413
- Lithium mercaptopropionate in depilatories 148
- Lithium thioglycolate in depilatories 148
- Lotion
  - definition 50
  - for hair dyes 532
- Lubricants in shaving foams 164
- Lubrication of skin 157, 174
- Lunula of the nail 363
- Lustre
  - of hair 430
  - of teeth 620
- Lymphocytes 10
  - in allergy 34
- Macromolecules, interaction with preservatives 695, 698
- Macrophages 10
  - in allergy 34
  - in delayed hypersensitivity 35
  - in inflammation 31
- Magnesium aluminium silicate in shampoos 446
- Magnesium carbonate
  - in baby powder 113
  - in face powders 291, 292, 309
  - in liquid make-up 310
  - in rouge 335
- Magnesium lauryl ether sulphate in shampoos 435
- Magnesium lauryl sulphate in shampoos 435, 453
- Magnesium oxide
  - in face powders 291, 292
  - in sunscreen products 232
- Magnesium peroxide
  - in face masks 282
  - in toothpastes 615
- Magnesium stearate
  - in face powders 288, 298
  - in shampoos 446
- Make-up cream 307
- Malachite for eye make-up 341
- Maleic alkyd resins in nail lacquers 377
- Manganese borate in bath salts 194
- Mannitol as humectant 647
- Manufacture, hygienic 676, 877
- Marasmus 403
- Marinol 665
- Mascara 341
  - application 359
  - cake or block 343
  - contamination 678
  - cream 344
- Massage creams 51, 60
- Massage, facial 356
- Mast cells 10, 11
  - in inflammation 31
- Materia alba 593
- MECSA antioxidant 725
- Medicines act 600
- Meissner corpuscles 12
- Melamine in depilatories 148
- Melanin 7, 261
  - formation 413
  - in hair 413
  - in solar protection 9
  - in tanning 222, 230
- Melanocytes 5, 7, 10, 264
  - in hair 413
  - in skin 43
- Melanocyte-stimulating hormone 9, 16, 47, 264
- Melanogenesis 222
- Melanosomes 8, 264, 413
- Melissa oil as insect repellent 207
- Membrane-coating granules 6
- Men's hairdressings 483
- Menthol
  - in astringents 75, 77, 78
  - in skin products 120
- Mepacrine, effect on nails 367
- Mercaptans as depilatories 146
- Mercapto-amines in skin lighteners 272
- Mercaptoethanol, effect on hair 412
- Mercaptopropanediol as depilatory 150
- Mercaptopropionic acid as depilatory 150, 152
- Mercaptoquinoline oxide in shampoos 459
- Mercaptoquinoxaline oxide in shampoos 459
- Mercurithiosalicylate, sodium ethyl, as preservative 687
- Mercury compounds
  - as antiseptics 670
  - for skin lightening 266
- Mercury salts as astringents 74
- Merkel cells 5
- Metabolism, microbial 676
- Metallized dyes 526, 527, 532
- Metals
  - in hair 410
  - in packaging 852
- Metering valves for aerosols 807
- Methyl eleostearate, oxidation 712
- Methyl ethyl ketone as nail lacquer remover 388
- Methyl linoleate 713, 723
- Methyl linolenate 713, 723
- Methyl oleate, oxidation 707, 710, 713, 723
- Methyl salicylate in sunscreens 256
- Methyl stearate, oxidation 713
- Methyl taurides in shampoos 436
- Methyl-B-nortestosterone in skin 46
- Methylcellulose 613
  - in eyeshadow 351
  - in face masks 278
  - in rouge 340
  - interaction with preservatives 695, 698
- Methylene chloride in propellants 816, 833, 834
- Methylglycerin as humectant 647
- Methylols for strengthening hair 575
- Methylpentanediol, interaction with preservatives 695
- METSAs antioxidant 725
- MGK insect repellants 210, 213, 214, 217, 218
- Mica in face powder 299
- Mica, titanium dioxide-coated
  - in eyeshadow 349, 351
  - in lipsticks 320
  - in rouge 335
- Micelles 634, 735
- Microbial flora of the body 654, 657
- Microbial growth in products 683
- Microbial metabolism 676
- Microbial standards 895
- Micrococci in products 678, 680, 681
- Microcrystalline waxes in hairdressings 485
- Micro-organisms
  - in mains water 866, 870
  - in products 877
- Micropulverizers 300
- Mildness of shampoos 427, 457
- Miliaria rubra 18
- Mineral oil
  - in aerosol antiperspirants 135
  - in all-purpose creams 71
  - in bath oils 105, 106
  - in cleansing creams 57, 58, 59
  - in depilatories 143
  - in eyeliner 351
  - in eyeshadow 350
  - in foundation creams 68
  - in hairdressings 484
  - in hand cleansers 89
  - in hand creams 70
  - in lip saives 331
  - in lipsticks 323, 327
  - in mascara 345, 346
  - in moisturizing creams 63, 65
  - in protective creams 85, 86
  - in rouge 335, 336, 337, 338

- Mineral oil (*cont.*)  
 in shampoos 445  
 in sunscreen products 250  
 Mineral oil, gelled 486  
 Minimum erythema dose 227, 240, 248  
 Minimum infective doses of pathogens 895  
 Mink oil  
 in hair conditioners 508  
 in shampoos 445  
 Mixing 757  
 dispersive 767  
 of liquids with liquids 793  
 of solids with liquids 786  
 of solids with solids 760  
 time 783  
 Moisturization 62  
 Moisturizers 109  
 Moisturizing creams 51, 60, 62  
 Moisturizing of skin 651  
 Moles 17  
 Molybdenum in water supplies 604  
 Monilethrix 416  
*Monilia albicans* 701  
 Monobloc aerosol cans 801  
 Monoethanolamine lauryl ether sulphates in shampoos 435  
 Monoethanolamine lauryl sulphate in shampoos 434  
 Monofluorophosphate  
 in toothpastes 601, 602, 616  
 reaction with enamel 603  
 Monoglyceride sulphates 634  
 in shampoos 435  
 Monoisopropyl citrate as antioxidant 721  
 Morpan 665  
 Moulding of lipsticks 329  
 Moulds in products 677  
 Moulting 15  
 Mucopolysaccharides  
 in moisturizing creams 63  
 in skin 42  
 Mud packs 280  
 Mutagenicity 522  
 Myristates in moisturizing creams 65  
 Myristyl myristate in hand cleansers 89, 91
- Nacreous pigments in nail lacquers 382  
 Nail bleaches 371  
 Nail creams 372  
 Nail driers 389  
 Nail elongators 389  
 Nail lacquer 375  
 base coat 385  
 manufacture 385  
 removers 386  
 top coat 385  
 Nail mending compositions 391  
 Nail patella syndrome 365  
 Nail polishes 374  
 Nail strengtheners 372  
 Nail white 373  
 Naphthol in hair tonics 503  
 Naphthosulphonates in sunscreen products 233  
 Naphthosulphonic acids in sunscreen products 237  
 Naphthylthiourea, effect on hair pigmentation 415  
 Nappies, cleansing 117  
 Nappy rash 111  
 Natural moisturizing factor in skin 64  
 Nerves of skin 11  
 Neutralizers  
 in cold waving 572  
 in hair straightening 584  
 Neutrophils  
 in delayed hypersensitivity 35  
 in inflammation 31  
 Niacin in skin lighteners 273  
 Nicotinates in hair tonics 503  
 Nicotinic acid deficiency 44  
 Night creams 51, 60  
 Niosomes in skin 64  
 Nitroaminophenol dyes 530
- Nitrocellulose  
 in nail lacquers 376  
 in nail mending compositions 391  
 Nitrogen as propellant 814, 815, 825  
 Nitromethane as corrosion inhibitor 834  
 Nitrophenylenediamine dyes 529  
 Nitrosamine formation 438  
 Nitrous oxide as propellant 814, 816  
 Nonionic surfactants 633  
 as preservatives 693  
 in foam baths 94  
 in shampoos 437, 447  
 interaction with preservatives 692, 693  
 Norbornylidene-pentenone, dimethyl-, in sunscreen products 243  
 Nordihydroguaiaretic acid as antioxidant 718, 722, 723, 724  
 Nutrition, effect on hair growth 402  
 Nutritive creams 60  
 Nylon  
 in nail lacquers 377  
 interaction with preservatives 696  
 titanium dioxide-coated, in face masks 278  
 Nylon fibres in mascara 346
- Octacalcium phosphate 592  
 Octaphen 665  
 Octopirox 422  
 Odland bodies 6  
 Odour  
 axillary 125, 132  
 body 124  
 foot 191  
 Oedema 30  
 caused by sunlight 223, 228  
 Oestrogens  
 absorption by skin 46  
 in hair growth  
 in sebaceous gland activity 16, 18  
 Oil absorption  
 by skin 103  
 of face powder materials 291  
 Oils, contamination 681  
 Oily skin, products 120  
 Oleates  
 in all-purpose creams 71  
 in baby products 113, 115  
 in cleansing creams 56, 57, 58  
 in hand creams 70  
 in moisturizing creams 65  
 Oleyl alcohol in hairdressings 488  
 Olive oil  
 in cold creams 55  
 in hairdressings 484  
 Omadine 671  
 Onycholysis 365  
 Opacifying agents  
 in foam baths 98  
 in shampoos 446  
 Opacity of face powder materials 287  
 Optical density of sunscreen films 245, 247  
 Organic fluorides in toothpastes 603  
 Organosilicon compounds in sunscreen products 235  
 Orpiment as depilatory 142  
 Orthocortex 581  
 Osmotic pressure, effect on microbial growth 685  
 OTC antiperspirant panel 128, 130  
 OTC sunscreen panel 240, 242, 248, 249  
 Oxidation dyes 533  
 bases 534  
 couplers 535  
 mechanism 535  
 modifiers 535  
 Oxidation of products 707  
 Oxidizing agents for skin lightening 266  
 Oxybenzone in sunscreen products 231, 243  
 Oxygen tension, effect on microbial growth 685  
 Oxygenated face mask 282  
 Ozokerite wax  
 in eyebrow pencil 352, 353

- Ozokerite wax (*cont.*)  
 in eyeshadow 350  
 in hairdressings 485  
 in lipsticks 323, 325, 327  
 in mascara 346  
 in rouge 336, 337, 338  
 in stick make-up 312
- Ozone layer, depletion by fluorocarbons 474, 810, 831
- Pacinian corpuscles 12
- Packaging  
 as source of contamination 894  
 for antiperspirants and deodorants 124  
 to prevent photodeterioration 725
- Paddle mixers 771
- Pangamic acid in skin creams 61
- Pantethine in skin creams 61
- Panthenol  
 in hair tonics 504  
 in setting lotions 473  
 in skin creams 61
- Pantothenic acid 416  
 in hair tonics 504  
 in skin creams 61
- Paper  
 in laminates 854  
 in packaging 855
- Parabens 614, 678, 688
- Paracortex 581
- Paraffin sulphonates  
 in foam baths 94  
 in shampoos 433
- Paraffin wax  
 in cleansing creams 57  
 in eyeshadow 349  
 in hairdressings 485  
 in mascara 346  
 in stick make-up 311
- Parahydroxybenzoates 614
- Parakeratosis 30
- Particle size  
 of aerosol antiperspirants 128  
 of aerosols 828, 845  
 of face powders 286, 300  
 of hair sprays 483
- Partition coefficient of preservatives 691, 697
- Patch test 35
- Peach kernel oil in hairdressings 484
- Peanut oil in hairdressings 484
- Pearlescent agents  
 in nail lacquers 382  
 in shampoos 446
- Peeling agents in acne products 121
- Pellagra 44
- Pellicle 590, 591
- Penicillium in products 679  
*Penicillium chrysogenum* 701  
*Penicillium notatum* 684
- Pennyroyal oil as insect repellent 207
- Peppermint oil as insect repellent 207
- Peptides, acyl, in shampoos 437
- Peracetic acid, effect on hair 412
- Percutaneous absorption 45
- Perfume atomizer 844
- Perfume solubilization 96
- Perfumes  
 as sensitizers 36  
 in bath oils 106  
 in bath salts 102  
 in deodorants 133  
 in face powders 296, 300  
 in foam baths 96  
 in hair sprays 477  
 in hair waving lotions 575  
 in lipsticks 322  
 in shampoos 432, 448  
 in shaving foams 164  
 in sunscreens 256  
 phototoxicity 38
- Periodontal disease 592, 595, 599
- Permeability of skin 45
- Peroxide  
 determination 718  
 in oxidation 708, 713, 717, 721  
 values 717
- Personnel as source of contamination 683, 891
- Perspiration 124
- Perspiration-resistance of sunscreen products 249
- Persulphate in hair bleach 548
- Petrolatum  
 in all-purpose creams 71  
 in baby products 113, 114  
 in cleansing creams 57, 58, 59  
 in massage and night creams 62  
 in protective creams 83  
 in sunscreens 243
- Petroleum jelly  
 in eyebrow pencil 352, 353  
 in eyeshadow 348, 349  
 in face powder 299  
 in lip salves 331  
 in lipsticks 322, 327  
 in mascara 345, 346  
 in rouge 336, 337, 338  
 in sunscreens 233
- pH  
 correlation with preservative activity 686, 697  
 effect on microbial growth 685, 686
- Phaeomelanin 9, 265, 413  
 in skin 43
- Phase inversion 56, 746, 747
- Phase separation 731
- Phermerol 665
- Phenol ether sulphates 634
- Phenolic resins  
 as lacquers for aerosol cans 837  
 as lacquers for tubes 853  
 in packaging 851
- Phenols  
 as antiseptics 654, 659  
 as preservatives 687, 688, 689, 698  
 for disinfection of plant 885
- Phenolsulphonates as astringents 74, 76, 78
- Phenoxyethyl alcohol as preservative 687, 691, 699
- Phenoxypropyl alcohol as preservative 687
- Phenyl salicylate in sunscreen products 244
- Phenylenediamines in hair dyes 534
- Phenylethyl alcohol in shampoos 445
- Phenylmercuric salts  
 as antiseptics 670  
 as preservatives 687, 688, 691, 700  
 in shampoos 447
- Phenyl-naphthylamine as antioxidant 718
- Phenylphenols as insect repellants 212
- Pheromones 126
- Phosphate esters in shampoos 446
- Phosphates in bath salts 101
- Phosphonium salts 635
- Phosphoric acid as antioxidant 718, 722, 725
- Photo-allergic reactions 37
- Photodeterioration 725
- Photosensitization by germicides 663
- Photo-toxic reactions 37
- Pigmentation of skin 7, 17
- Pigments  
 in face powders 286  
 in lipsticks 318, 328  
 interaction with preservatives 695  
 ultraviolet transmission 287
- Pili annulati 416
- Pili torti 416
- Pilocarpine in hair tonics 503
- Pilomotor agents in shaving products 165, 177
- Pilosebaceous apparatus 119
- Pimento oil as insect repellent 207
- Pimples 119
- Pin disc mills 300
- Pin mill 766
- Pin perms 574

- Pine oil as insect repellent 207  
 Pine tar oil in hair tonics 504  
 Piperonyl ether butoxide as insect repellent 207  
 Pipework for water systems 872  
 Piston pack aerosols 839  
 Pituitary hormones in skin 47  
 Pityriasis capitis 19  
*Pityrosporum orbiculare* 19, 419  
*Pityrosporum ovale* 19, 419, 421, 458  
 Placenta extract in hair tonics 504  
 Plant, contamination 682  
 Plaque, dental 590, 591  
 Plastic containers for aerosols 802  
 Plastic fingernails 389  
 Plastic fluids 769  
 Plasticizers  
   in hair sprays 476, 477  
   in nail elongators 389  
   in nail lacquers 377  
   in setting lotions 471  
 Plastics  
   in face powders 291  
   in packaging 850  
   interaction with preservatives 696  
 Plough-shear mixer 766  
 Polish on teeth 620  
 Pollen in skin creams 61  
 Polyalkoxylated derivatives in shampoos 438  
 Polyalkoxylated ether glycolates in shampoos 437  
 Polyalkylene glycols in aerosol antiperspirants 135  
 Polyester films in laminates 854  
 Polyethylene glycol alkylethers in shampoos 445  
 Polyethylene glycol as humectant 643, 647  
 Polyethylene glycol derivatives 636  
 Polyethylene glycol ester sulphates 634  
 Polyethylene glycols  
   in hair conditioners 508  
   in hairdressings 484, 488, 494  
   in setting lotions 472  
   interaction with preservatives 694, 695, 698  
   in packaging 850  
 Polyethylene wax in baby products 113  
 Polyethyleneimine amides 636  
 Polyglyceryl ethers in shampoos 439  
 Polyglycol esters 636  
 Polyisobutylene in nail elongators 389  
 Polymeric sunscreen materials 239  
 Polymers, adsorbing, in antiperspirants 130  
 Polymers in setting lotions 471  
 Polymethacrylic acid in shampoos 445  
 Polyolefins in packaging 850, 861  
 Polyoxyethylene glycol as humectant 647  
 Polyoxyethylene sorbitol as humectant 647  
 Polyphenols in hair tonics 504  
 Polypropylene glycol alkylethers in shampoos 445  
 Polypropylene glycols in hairdressings 484, 488  
 Polypropylene in packaging 850, 854  
 Polysiloxanes  
   in hair sprays 477  
   in setting lotions 472  
 Polystyrene  
   in face powders 292  
   in nail elongators 389  
   in packaging 851, 862  
 Polythene  
   in face powders 292  
   in laminates 854  
   in packaging 850  
   in products for oily skin 121  
 Polyunsaturated compounds, oxidation 711  
 Polyurethane, interaction with preservatives 696  
 Polyvinyl alcohol in face masks 277, 278  
 Polyvinyl alcohols in shampoos 446  
 Polyvinyl chloride in packaging 850, 854  
 Polyvinylpyrrolidone  
   in coloured setting lotions 528  
   in face masks 278  
   in hair sprays 476  
   in hairdressings 488  
   in setting lotions 471  
   in shampoos 446  
   interaction with preservatives 695  
 Polyvinylpyrrolidone-iodine complex  
   as antidandruff agent 499  
   in shampoos 458  
 Polyvinylpyrrolidone-vinyl acetate copolymers  
   in hair sprays 476  
   in setting lotions 472  
 Pomades 485  
 Porositones in foundation creams 67  
 Potash alum in nail strengtheners 373  
 Potassium aluminium sulphate as antiperspirant agent 129  
 Potassium cyanide, effect on hair 412  
 Powder  
   application 358  
   pigmented 762, 765  
 Powder sprays, aerosol 827  
 Powder valves for aerosols 806  
 Powders  
   cohesive 760  
   segregating 760  
   storage 766  
 Power number 783  
 Preservatives  
   in foam baths 97  
   in shampoos 431, 447  
   in shaving foams 164  
   in toothpaste 614  
 Pressure depressants for aerosols 810  
 Preval aerosol 842  
 Prick test for soluble antigens 37  
 Prickly heat 18  
 Primary irritation 38  
 Printing on packages 858  
 Procollagen 10  
 Proline in antioxidants 724  
 Propane as propellant 479, 811  
 Propanediol, bromonitro-, as preservative 687, 690, 693  
 Propanediol, chlorophenyl-, as preservative 687  
 Propanediol, interaction with preservatives 695  
 Propellants  
   effect on ozone layer 474, 810, 831  
   in aerosol shaving foams 164, 166  
   toxicity 483  
 Propeller mixers 773  
 Propionates in athlete's foot products 202, 203  
 Propionic acid as preservatives 687, 689  
 Propyl gallate as antioxidant 718, 721, 722  
 Propylene glycol  
   as humectant 643, 645, 646, 647, 650  
   as preservative 692  
   in anti-wrinkle products 283  
   in face masks 278  
   in hand cleansers 89, 90  
   in moisturizing creams 64, 65  
   interaction with preservatives 695  
 Propylene glycol glucoside as humectant 647  
 Propylene glycol palmitate in shampoos 446  
 Propylene glycol stearate in shampoos 446  
 Prostaglandins in irritation 31  
 Protective creams 51  
 Protein deficiency 44  
   effect on hair growth 44  
 Protein hydrolysates  
   in hair conditioners 507  
   in hair sprays 477  
 Protein, hydrolysed, in moisturizing creams 63  
 Proteins  
   in hairdressings 484  
   in setting lotions 473  
   in shampoos 445  
   interaction with preservatives 697  
   synthesis in skin 43  
 Proteolytic theory of dental decay 596  
 Pseudofolliculitis barbae 151  
*Pseudomonas aeruginosa* 701  
   in nail infections 367  
*Pseudomonas* sp. in products 678, 679, 684, 685  
 Pseudoplasticity 768

- Psoralens  
   for treatment of vitiligo 17  
   in suntan products 224, 258  
 Psoriasis 19  
   effect on nails 365, 366  
   Pumice in nail cleaners 371  
   Pump applicators 844, 860, 861  
   for hair sprays 478  
   Pumping capacity 786  
   Purcellin oil in vanishing creams 62  
   PVP-iodine complex  
     as antidandruff agent 499  
     in shampoos 458  
   Pyrethrum as insect repellent 206, 212  
   Pyridine-N-oxides as antiseptics 671  
   Pyridinethiol-N-oxide derivatives as antidandruff agents 421, 458, 499  
   Pyridinethiones as antiseptics 671  
   Pyrogallol as antioxidant 723  
  
 Quaternary ammonium compounds 654  
   as antidandruff agents 499  
   as antiseptics 665  
   as preservatives 687, 688, 690, 694, 695, 700  
   for disinfection of plant 682, 887  
   in baby products 112  
   in cuticle softeners 371  
   in hair conditioners 506, 513, 516  
   in mouthwashes 628  
   in setting lotions 473  
 Quaternary ammonium surfactants in shampoos 458  
 Quaternium-18, contamination 893  
 Quaternized amides  
   of ethylenediamine 635  
   of polyethyleneimine 635  
 Quaternized diamine salts 635  
 Quince seeds, mucilage, in mascara 344  
 Quinine salts  
   in hair tonics 503  
   in sunscreens 233, 237  
 Quinoline derivatives in sunscreens 233  
 Quinquina in hair tonics 503  
  
 Radiotracer method for abrasivity of toothpaste 619  
 Rancidity 717  
 Rate of shear 768  
 Raw materials, contamination 681, 893  
 Rayon fibres  
   in mascara 346  
   in nail mending products 391  
 Razor blades, corrosion 171, 174  
 Reactive dyes 531  
 Reducer in cold waving 570  
 Reducing agents in hair waving 558  
 Refractive index of face powder materials 286  
 Regeneration time of cells 5  
 Relaxers in hair straightening 583  
 Remineralization of enamel 604  
 Replacement time of cells 5  
 Resins in hair sprays 475  
 Resorcinol  
   as antidandruff agent 421, 499  
   as antiseptic 654  
   in acne products 121  
 Reticulin 11  
 Retinoic acid  
   in acne products 122  
   in skin lighteners 270, 271  
 Reverse osmosis for purification of water 869  
 Reynolds number 767, 783, 786, 788  
*Rhodotorula rubra* in products 679  
 Rhubarb extract in hair tonics 503  
 Rhusma as depilatory 142  
 Ribbon blender 763  
 Riboflavine deficiency 44  
 Ribosomes 43  
 Ricinoleates in deodorants 133  
 Ringed hair 416  
 Ringworm of the feet 192  
 Rinses for hair 513  
  
 Rinsing of shampoo 430  
 Robertson-Berger meter 248  
 Roccal 665  
 Roll ball applicators 860  
   for antiperspirants 138  
   for pre-shave lotions 177  
 Roll mill 779  
 Roller perms 574  
 Rolling skin preparation 201  
 Roll-on antiperspirants 138  
 Rose water in astringents 75, 76  
 Rosin  
   in depilatories 142  
   in mascara 347  
 Rosins, wood, in shampoos 445  
 Rouge  
   application 358  
   compact 334  
   dry 334  
   liquid 340  
   wax-based 336  
 Royal jelly in skin creams 61  
 Rubber  
   as propellant reservoir 167  
   in depilatories 143  
   interaction with preservatives 696  
 Rubber ball pump 844  
 Rubber-based face masks 277  
 Ruffini end organs 12  
 Rutgers 612 207, 208  
  
 Salicylanilides 657, 662  
   halogenated, in shampoos 458  
 Salicylates  
   as astringents 74  
   in sunscreens 233, 234, 236, 243, 247  
 Salicylic acid  
   as antidandruff agent 19, 421, 499  
   as preservative 687, 689  
   effect on nails 366  
   in acne products 122  
   in face masks 282  
   in ointments 45  
 Saliva 590  
 Salol in sunscreen products 256  
 Salt links in keratin 406  
 Sand mill 780  
 Sandalwood oil as insect repellent 207  
 Sarcosinates 634, 638  
 Sarcosinates, acyl-, in shampoos 436  
 Sassafras oil as insect repellent 207  
 Saturated compounds, oxidation 713  
 Scalp-up 788  
 Scalp, area 525  
 Schiff test for aldehydes 719  
 Scum 168  
 Sea salt foot baths 194  
 Sebaceous glands 15, 119, 124  
 Seborrhea 500  
 Seborrheic dermatitis 420  
 Sebum 16, 43, 124  
   composition 16  
   effect on hair 427  
   excretion 500  
   in acne 119, 120  
 Secondary alkyl sulphates 634  
 Segregation of mixtures 760  
 Selenium disulphide 654  
   as antidandruff agent 19, 421, 499  
 Sensitization by preservatives 700  
 Sensitizers 35, 39  
 Sepro can aerosol 839  
 Sequestering agents in shampoos 431, 447  
 Sericine in hair tonics 504  
 Sesame oil  
   in cleansing creams 55  
   in foundation creams 69  
   in hairdressings 484  
   in shampoos 445



- Sesamol as antioxidant 724  
 Setting lotions 470  
   coloured 528  
 Shampoos  
   acid balanced 459  
   aerosol 454, 830  
   antidandruff 458  
   baby 435, 457  
   basic requirements 427  
   clear liquid 449  
   conditioning 455  
   detergency 428  
   dry 454  
   for hair dyes 533  
   gel 451  
   instrumental evaluation 431  
   liquid cream 450  
   lotion 450  
   mild 434, 457  
   oil 453  
   powder 453  
   raw materials 431  
   safety 431, 460  
   solid cream 451  
 Shaving cream  
   brushless 171  
   cream, lather 159  
   foam, aerosol 161, 829, 840  
   foam, heated 167, 840  
   foam, pre-electric 178  
   gel stick, pre-electric 173  
   lotion, pre-electric 176  
   lotion, pre-shave 75  
   powder, pre-electric 174  
   stick 161  
   stick, brushless 173  
   talc stick, pre-electric 173  
 Shear stress 768, 778  
 Shellac  
   in eyeliner 351  
   in hair sprays 475  
   in setting lotions 471  
 Silica  
   in baby powders 113, 116  
   in face powders 291, 294  
   in nail polishes 374  
   in nail white 373  
   in products for oily skin 121  
   in setting lotions 473  
 Silicates  
   in face powders 294  
   in setting lotions 473  
 Silicon compounds, organo-, in sunscreens 235  
 Silicones  
   in aerosol antiperspirants 135  
   in antiperspirant creams 137  
   in antiperspirant roll-ons 138  
   in antiperspirant sticks 137  
   in baby products 113, 115  
   in hair conditioners 508  
   in hair rinses 517  
   in hair straightening 581  
   in hand creams 70  
   in lip salves 331  
   in lipsticks 323  
   in mascara 344, 345  
   in moisturizing creams 63, 65  
   in protective creams 83, 84, 85, 86  
   in setting lotions 472  
   in shampoos 445  
   in shaving products 157, 164, 172, 174, 175  
 Silicone waxes in lipsticks 322  
 Silk, powdered, in face powders 294  
 Silver metal in eye cosmetics 342  
 Silver salts as astringents 74  
 Skin  
   amino acids 43  
   area in human beings 3  
   blood vessels 12  
   colour 264  
   disorders 16  
   friction 157  
   innervation 11  
   lipids 43  
   lubrication 157  
   permeability 3  
   pigmentation 7, 43, 47  
   racial differences 264  
   respiration 43  
   temperature control 13  
   weight in human beings 3  
   wounding 47  
 Skin bacteria of plant operators 891  
 Skin fresheners 75  
 Skin test for hair dyes 539  
 Skin toners 75, 76  
 Slip of face powder materials 292  
 Slip point of creams 51  
 Soap-based mouthwashes 627  
 Soaps  
   antibacterial 656  
   as emulsifiers in hand cleansers 89  
   as preservatives 693  
   in shaving creams 159, 171  
   interaction with preservatives 697  
 Sodium aluminium chlorohydroxylactate as antiperspirant agent 129, 136  
 Sodium benzoate in toothpastes 614  
 Sodium bicarbonate in deodorants 132  
 Sodium bisulphite as antioxidant 718  
 Sodium carbonate in bath salts 101  
 Sodium carboxymethylcellulose  
   in face masks 278  
   in hairdressings 490  
 Sodium chloride in bath salts 102  
 Sodium fluoride in toothpaste 601, 602, 615  
 Sodium formaldehyde sulphoxylate as antioxidant 718  
 Sodium hypochlorite  
   as antiseptic 670  
   in denture cleansers 624  
   in mouthwashes 628  
 Sodium lactate as humectant 643, 645, 647  
 Sodium lauryl ether sulphate  
   in foam baths 93  
   in shampoos 435  
   in toothpastes 612  
 Sodium lauryl sulphate  
   in foam baths 93  
   in shampoos 434  
   in toothpastes 611  
 Sodium metabisulphite as antioxidant 718  
 Sodium metaphosphate, insoluble 611  
 Sodium metasilicate in depilatories 149  
 Sodium monofluorophosphate  
   in toothpastes 602, 616  
   reaction with enamel 603  
 Sodium N-lauroyl sarcosinate in toothpastes 598, 600  
 Sodium perborate  
   in denture cleansers 622  
   in mouthwashes 628  
   in nail bleaches 371  
   in toothpastes 615  
 Sodium percarbonate in denture cleansers 622  
 Sodium pyrrolidone carboxylate in skin 64  
 Sodium ricinoleate in toothpastes 612  
 Sodium sesquicarbonate in bath salts 101  
 Sodium stearate in deodorant sticks 139  
 Sodium sulphide  
   as depilatory 145  
   effect on hair 412  
 Sodium sulphite as antioxidant 718  
 Sodium sulphuricinate in toothpastes 612  
 Sodium thiosulphate as antioxidant 718  
 Sodium xylene sulphonate in shampoos 446  
 Soft permanent waves 563, 575  
 Solder for aerosol cans 801  
 Solehorn of the nail 363  
 Solid dentifrice 618  
 Solids, interaction with preservatives 695

- Solubilization 638  
 Soluble bath oils 107  
 Solvent-assisted hair dyeing 524, 532  
 Solvent extraction of hair 428  
 Solvents  
   for nail lacquers 378  
   in hair sprays 477  
   in shampoos 446  
 Sorbic acid as preservative 687, 689, 696, 698, 700  
 Sorbitan sesquiolate in hairdressings 492  
 Sorbitol  
   as humectant 612, 643, 644, 645, 646, 647, 650, 651  
   in all-purpose creams 71  
   in face masks 277  
   in moisturizing creams 64, 65  
   inhibition of bacteria 685  
   metabolization 684, 697  
 Sorbitol esters, polyoxyethylated, in shampoos 439  
 Spermaceti  
   in cleansing creams 55, 57, 58  
   in eyeshadow 348, 349  
   in foundation creams 68  
   in hairdressings 485  
   in mascara 346  
 Split ends of hair 508  
 Spoilage of products 675, 677  
 Spoon nails 366  
 Sports creams 71  
 Spots, incidence 119  
 Spreading bath oils 104  
 Spreading coefficient 105  
 Spreading of shampoo 430  
 Squalane  
   in cleansing creams 58  
   in hand creams 70  
 Squeeze packs 844, 859  
 Staining  
   of clothes by aerosol antiperspirants 134, 135  
   of scalp by hair dyes 525  
 Staining dyes in lipsticks 315  
 Stains for artificial skin tanning 258  
 Stannic oxide in nail polishes 374  
 Stannites as depilatories 146  
 Stannous fluoride in toothpastes 601, 602, 616  
 Stannous fluorozirconate in toothpastes 604  
 Staphylococci in products 678, 680  
*Staphylococcus albus* in acne 120  
*Staphylococcus aureus* 678, 701  
   in acne 120  
   on plant operatives 892  
*Staphylococcus epidermidis* 18  
   in foot odour 191  
   on plant operatives 891  
 Starch  
   contamination 682  
   degradation 684  
   in antiperspirants 129, 137  
   in baby powders 113, 117  
   in face powders 290, 291, 292, 294, 297, 298, 299, 302, 303, 308  
 Starch ethers in toothpastes 613  
 Static electricity on hair 431  
 Static mixers 776  
 Steam disinfection of plant 884  
 Stearates  
   in all-purpose creams 71  
   in baby products 113, 115  
   in body powders 108  
   in cleansing creams 56, 57  
   in face powders 286, 291, 297, 298, 299, 302, 304, 307, 310  
   in foundation creams 68, 69  
   in hand creams 70  
   in moisturizing creams 63  
 Stearic acid  
   in all-purpose creams 71  
   in hand creams 70  
   in rouge 339  
   in skin creams 83, 84, 86, 89, 90  
   in vanishing creams 66  
 Stearin  
   in face powder 299, 302  
   in rouge 339  
 Stearyl alcohol  
   in antiperspirant sticks 136  
   in shampoos 446  
 Stick applicators 860  
   for antiperspirants 136  
   for deodorants 139  
   for depilatories 149  
   for make-up 311  
 Stinging 32  
 Stockings, cosmetic 309  
 Stone mills 778  
 Storage testing of aerosols 838  
 Stratum basale 5  
 Stratum corneum 6  
   hydration 45  
 Stratum germinativum 5  
 Stratum granulosum 6  
 Stratum intermedium 6  
 Stratum lucidum 6  
 Stratum spinosum 6  
*Streptococcus mitis* 701  
 Strontium sulphide as depilatory 145  
 Strontium sulphhydrate as depilatory 145  
 Styptic pencils 75, 80  
 Styrax, tincture, in rouge 341  
 Sucrose esters in baby products 114  
 Sugar, role in dental caries 596  
 Sugar syrup in mascara 344  
 Sulphates as astringents 74  
 Sulphides as depilatories 145  
 Sulphites  
   in hair straightening 585  
   in hair waving 558  
   in nail bleaches 371  
 Sulphonated oils in hand cleansers 88  
 Sulphonated polystyrenes in setting  
   lotions 473  
 Sulphonium salts 635  
 Sulphonyl fatty acids 634  
 Sulphosuccinates  
   in foam baths 94  
   in shampoos 435  
 Sulphosuccinates, dialkyl- 634  
 Sulphur  
   as antidandruff agent 421, 499  
   as antiseptic 654  
   in acne products 121  
   in face masks 281  
   in hair tonics 503  
 Sulphurous acid as preservative 687, 689  
 Sun products, aerosol 825  
 Sun Protection Factor 240, 248  
 Sunburn 223, 228, 230  
 Sunflower seed oil 44  
   in hairdressings 484  
 Sunlight, effects on the body 222  
 Sunscreen index 234, 245, 247  
 Superamides in shampoos 438  
 Surface energy 632  
 Surface tension 731, 735, 738  
   effect on microbial growth 685  
 Surfactants  
   for shampoos 432  
   in shaving products 157, 163, 169  
   in toothpastes 609, 611  
   metabolization 684, 697  
   physical properties 464  
 Suspending agents  
   for nail lacquers 383  
   for shampoos 432  
 Suspension of solids in liquids 792  
 Sweat 14  
   glands 13, 125  
 Sweating 13, 124  
 Sweetening agents in toothpastes 614  
 Swelling agents in hair straightening 585  
 Swift stability test for rancidity 720

- Synergism  
 in antioxidants 716  
 in antiseptics 672  
 in preservatives 691
- Tablet for toothcleaning 597
- Talc  
 in baby powder 113, 117  
 in eyeliner 351  
 in face powders 286, 288, 291, 292, 293, 297, 298, 299, 303, 304, 305, 306, 308, 309  
 in liquid make-up 310  
 in make-up cream 307  
 in nail polishes 374  
 in products for oily skin 121  
 in protective creams 83  
 in rouge 334, 335, 337  
 in sunscreens 232  
 interaction with preservatives 695  
 pre-electric shave stick 173  
 sterilization 113
- Talcum powder 108
- Tannic acid  
 in mouthwashes 628  
 in sunscreens 233, 256
- Tanning 222, 225
- Tar  
 as dandruff treatment 421  
 in hair tonics 504
- Tartaric acid  
 interaction with preservatives 695  
 role in oxidation 717, 725
- Tartrates as astringents 74
- Taurides, methyl-, in shampoos 436
- Taurines 634
- Tea-tree oil as insect repellent 207
- Tellurium dioxide as dandruff treatment 421
- Telogen 14, 398
- Telogen effluvium 415, 416, 417
- Temperature control in skin 13
- Temperature, effect on microbial growth 686
- Teratogenicity 522
- Terminal hair 15, 398
- Terpenes in deodorants 133
- Testosterone  
 in hair growth 15, 418  
 in sebaceous gland activity 16  
 in skin 46, 47  
 in skin pigmentation 9
- Tetrachlorophene 672
- Tetrachlorosalicylanilide 663  
 as preservative 687  
 phototoxicity 38
- Tetracycline  
 effect on nails 367  
 in acne therapy 18, 123
- Tetramethylthiuram disulphide 657, 669, 671  
 as preservative 687
- Thermoplastic resins in packaging 850
- Thermosetting resins in packaging 851
- Thesauriosis caused by hair sprays 482
- Thiamine hydrochloride as insect repellent 206
- Thickening agents for shampoos 432
- Thickening of hair 512
- Thinning agents for shampoos 432
- Thiodiglycol as depilatory 152
- Thiodipropionates as antioxidants 725
- Thiodipropionic acid as antioxidant 721
- Thiodisuccinic acid, esters, as antioxidants 725
- Thioglycerol  
 as antioxidant 718  
 as depilatory 150, 152
- Thioglycollates  
 as depilatories 146, 148, 149  
 effect on hair 412, 558, 559, 560, 570  
 in hair straighteners 583
- Thioglycollic acid  
 as antioxidant 718  
 in hair dyes 532  
 in hair waving 558, 570
- Thiolactates as depilatories 148
- Thiolactic acid as depilatory 148, 150, 153
- Thiols in hair waving 558, 560
- Thiomaic acid as depilatory 152
- Thiomersal preservative 691
- Thiosorbitol as antioxidant 718
- Thiouracil, effect on hair pigmentation 415
- Thiourea in depilatories 149
- Thixotropy 769
- Thymol  
 in mouthwashes 627  
 in shampoos 458
- Thymol derivatives as preservatives 687
- Thyroxine 401
- Tin compounds  
 as astringents 74  
 in toothpaste 604
- Tin, corrosion 835
- Tin tubes for packaging 853
- Tinea pedis 192
- Tinea unguium 192
- Tinplate, corrosion 836
- Tinplate cans for aerosols 801
- Titanium compounds in toothpaste 604
- Titanium dioxide  
 in cosmetic stockings 310  
 in eye cosmetics 342  
 in eyeliner 351  
 in eyeshadow 348, 350  
 in face powders 285, 292, 298, 304, 305, 306, 308  
 in lipsticks 318  
 in liquid make-up 310, 311  
 in make-up cream 307  
 in nail lacquers 381  
 in nail white 373  
 in rouge 334, 335, 336, 337  
 in shampoos 446  
 in stick make-up 311, 312  
 in sunscreens 231, 232, 233, 243  
 interaction with preservatives 695
- Tocopherols as antioxidants 718, 721, 722, 724, 725
- Toe-nails, in-growing 192
- Toilets in manufacturing plant 892
- Toluenediamines in hair dyes 535
- Tonofibrils 6
- Tonofilaments 6
- Toothbrush 621  
 electric 622
- Toothbrushing 621
- Toothcleaning tablet 597
- Toothpaste  
 aerosol 825  
 formulation 615  
 manufacture 616  
 striped 615, 860  
 transparent 611
- Toothpowders 617  
 manufacture 618
- Toxicity  
 of antioxidants 723  
 of hair dyes 522, 525, 538  
 of hair sprays 481  
 of hair waving lotions 575  
 of humectants 642, 651  
 of preservatives 699  
 of propellants 483  
 of surfactants 639
- Tragacanth gum in shampoos 446
- Transepidermal water loss 62
- Transfer valves for aerosols 808
- Transit time of cell cycle 5
- Transition cells 6
- Transparent lipsticks 330
- Transparent toothpaste 611
- Tretinoin in acne products 122
- Tri-aerosol 840
- Tribromosalicylanilide 654, 657, 663
- Tribromsalan in deodorant soaps 139
- Tricalcium phosphate 610
- Tricarboxylic acid cycle in skin cells 42

- Trichlorocarbon in deodorant soaps 139  
 Trichlorocarbaniide 654, 657, 658, 663, 672  
   as preservative 687  
   in shampoos 458  
 Trichloroethane in propellants 816, 832, 834  
 Trichlorophenylacetic acid as preservative 687  
 Trichlorosalicylanilide 657, 663  
   as preservative 687  
*Trichophyton floccosum* in foot odour 191  
*Trichophyton interdigitale* in athlete's foot 192  
*Trichophyton mentagrophytes* in athlete's foot 192  
*Trichophyton rubrum* in athlete's foot 192  
*Trichophytosis pedis* 192  
*Trichorrhexis nodosa* 416  
*Trichorrhexis invaginata* 416  
 Trichosiderins in hair 413  
 Triclosan  
   in deodorants 132, 139, 140  
   in skin products 120  
   in sunburn products 258  
 Triethanolamine as humectant 647  
 Triethanolamine lactate as humectant 647  
 Triethanolamine lauryl ether sulphate in shampoos 435  
 Triethanolamine lauryl sulphate in shampoos 435  
 Triethanolamine soaps in shampoos 446  
 Triethanolamine stearate in sunburn products 257  
 Triethylene glycol as humectant 647  
 Trigger sprayers 845  
 Trihydroxybutyrophenone as antioxidant 721, 724  
 Triphenylmethane dyes 527  
 Triple roll mill 779  
 Tropocollagen 10  
 Tubes for packaging 852, 854, 860  
 Turbine mixers 771  
 Turbulent flow 767  
 Turkey red oil in toothpastes 612  
 Turnover time of cell cycle 5  
 Turpentine in hair tonics 503  
 Tyrosinase in melanin formation 8, 265, 267, 413, 415  
 Tyrosine in melanin formation 9, 43, 265, 268, 413
- Ultrafiltration of water 869  
 Ultrasonic homogenizer 780  
 Ultraviolet absorbers for shampoos 432  
 Ultraviolet radiation—A, B and C ranges 226  
 Ultraviolet sterilization of water 871  
 Umbelliferone in sunscreen products 235, 236, 247  
 Undecenoic acid as insect repellent 211  
 Undecenyl alcohol as insect repellent 212  
 Undecylenates in athlete's foot products 203  
 Undecylenic acid ethanolamides in shampoos 458  
*Ungulina officinalis* extract in deodorants 133  
 Urea  
   absorption by skin 45  
   as humectant 647  
   in cuticle softeners 371  
   in toothpastes 601  
   interaction with preservatives 697  
 Urea-bisulphite, effect on hair 412  
 Urea-formaldehyde foam in face powders 291  
*Urginea maritima* in hair tonics 503  
 Uric acid in sunscreen products 233  
 Urocanic acid in skin 230  
   in skin lighteners 273  
 Urticaria 31
- Vaccine against dental caries 598  
 Valerolactone as nail lacquer remover 387  
 Valve homogenizer 779  
 Vancide 669  
   as dandruff treatment 421  
 Vanillic acid as preservative 687  
 Vanillin  
   as preservative 687  
   in athlete's foot products 204  
 Vanishing creams 51, 62  
 Vantoc 665  
 Vapour phase taps for aerosols 807  
 Vapour pressure of propellants 810, 811, 812  
 Vaseline in face powder 299
- Vegetable extracts in moisturizing creams 63  
 Vegetable oils  
   in depilatories 143  
   in hairdressings 484  
   in moisturizing creams 63, 65  
 Vellus hair 15  
 Velocity head 786  
 Venturi aerosols 841, 844  
 Verrucae 191  
 Vertical vortex mixer 766  
 Vinyl acetate-crotonic acid copolymers  
   in hairsprays 476  
   in setting lotions 472  
 Vinyl-based face masks 277  
 Vinyl emulsions in shampoos 446  
 Vinyl latexes in shampoos 446  
 Vinyl resins as tube lacquers 853  
 Violuric acid in sunscreen products 233, 237  
 Viscosity 768  
   of foam baths 97  
   of humectants 642, 647  
 Viscosity modifiers in shampoos 432, 446  
 Vitamin A  
   deficiency in skin 44  
   in acne products 122  
   in skin lighteners 270  
 Vitamin B<sub>2</sub> deficiency 44  
 Vitamin C  
   deficiency 44  
   in prickly heat therapy 19  
 Vitamin D in skin 223, 265  
 Vitamins  
   effect on hair growth 402  
   in hair tonics 504  
   in hairdressings 484  
   in skin creams 61  
 Vitiligo 17
- Wads for closures 860  
 Walls, cleanliness 878  
 Warburg-Dickens shunt in skin cells 42  
 Warburg respirometer 720  
 Washability of skin creams 59  
 Washrooms in manufacturing plant 892  
 Water absorption of face powder materials 292  
 Water-based aerosols 830  
 Water bath testing of aerosols 821  
 Water, contamination 681, 865  
 Water fluoridation 598  
 Water jets for toothcleaning 622  
 Water loss from skin 62, 111, 651  
 Water resistance of sunscreen products 249  
 Wax, depilatory 142  
 Wax-based face masks 276  
 Waxes  
   contamination 681  
   in cleansing creams 57, 58, 59  
   in foundation creams 68  
   in hair conditioners 508  
   in hairdressings 485  
   in lipsticks 321, 328  
   in massage and night creams 62  
   in moisturizing creams 65  
   in rouge 336  
 Wet white face powder 307  
 Wetting 637  
 Wheat germ oil in hair conditioners 508  
 White spot lesion 595  
 Whitlockite 592  
 Witch hazel distillate as astringent 75  
 Women's hairdressings 470  
 Wool  
   composition 404, 409  
   properties 412  
 Wool wax alcohols in hairdressings 492  
 Wormwood oil as insect repellent 207
- Xanthene dyes 527  
 Xylenol, métadichloro- 659

- Xylenols as preservatives 687, 692  
 Xylitol as humectant 647
- Yeasts  
 in products 678, 679, 680, 681, 701  
 in raw materials 681
- Yellow nail syndrome 367
- Zephiran 666  
 Zeta potential 742  
 Zinc acetate in nail hardeners 373  
 Zinc and castor oil ointment 116  
 Zinc hydroxymethylsulphinate as antidandruff agent 499  
 Zinc in hair 410  
 Zinc omadine as antidandruff agent 421  
 Zinc oxide  
 in baby products 113, 116, 117  
 in cosmetic stockings 309  
 in eye cosmetics 342  
 in eyeshadow 348  
 in face powders 286, 292, 297, 298, 299, 303, 305, 306, 308  
 in foundation creams 69  
 in liquid make-up 310  
 in nail white 373  
 in protective creams 83  
 in rouge 334, 335  
 in shampoos 446
- in sunburn products 257  
 in sunscreen products 231, 232, 233  
 interaction with preservatives 695  
 Zinc peroxide in nail bleaches 371  
 Zinc phenolsulphonate 654  
 Zinc pyridinethiol-N-oxide 654, 671  
 as antidandruff agent 421  
 in shampoos 458  
 Zinc pyrithione as antidandruff agent 19, 421  
 Zinc ricinoleate in deodorants 133  
 Zinc salts  
 as astringents 74, 75, 76, 77  
 in mouthwashes 628  
 in toothpastes 604  
 Zinc stearate  
 in cosmetic stockings 310  
 in eyeshadow 351  
 in face powders 288, 291, 292, 297, 298, 299, 304  
 in protective creams 83  
 in rouge 334, 335  
 in shampoos 446  
 Zinc sulphate in acne therapy 123  
 Zinc undecylenate  
 in athlete's foot products 203  
 in shampoos 458  
 Zirconium chloride in nail strengtheners 373  
 Zirconium compounds as antiperspirants 127, 137  
 Zirconium fluoride in toothpastes 604  
 Zirconium salts as astringents 74, 75  
 Zirconium silicate in toothpastes 611



