with affinities for different food materials in the circulation. While one or two side chains of a cell are concerned in the process of intoxication and antitoxin formation, the rest continue to function normally.

Ehrlich's theory explains readily the origin and mode of action of the cytolysins, agglutinins, etc.

If an animal be treated with inoculations of bacteria in doses less than fatal, the serum of the animal acquires several new properties.

If a few drops of the serum are added to a few drops of suspension of bacteria of the species injected, the bacteria lose their motility and collect in clumps and balls, that is to say, they become "agglutinated." Those substances in the serum which produce agglutination are termed "agglutinins."

The serum of the inoculated animal frequently shows another new property. If a few drops of the serum are added to a culture of the bacterium in fluid medium some products of bacterial action dissolved in the liquid are precipitated from solution. These substances in the serum which cause such a precipitation are called "precipitins."

Frequently the serum of the inoculated animal acquires the power of completely dissolving the bacteria. Such a serum is called a "bacteriolytic" serum. The substances in the serum which cause the dissolution of the bacteria are called "bacteriolysins," or less strictly "lysins." The process of disintegration of the bacteria is called "bacteriolysis" or simply "lysis."

The process of bacteriolysis was first described by R. Pfeiffer, and is known as "Pfeiffer's phenomenon." Several valuable additions were made to Pfeiffer's description by Metschnikoff and Bordet. The most important discovery was made by Bordet, who found that it is just as easy to immunize animals against other cells as against bacteria. Bordet inoculated guinea-pigs with the red blood corpuscles of rabbits, and found that the serum of the guinea-pig acquired the power of agglutinating and also of dissolving the corpuscles of the rabbit. These observations have been extended so that now it can be stated as a general law "that the serum of an individual of species A, which has been treated with . . . inoculations of the erythrocytes of species B acquires new properties which enable it to dissolve the erythrocytes of species B" (Sachs, Lubarsch-Ostertag, vii. Jahrgang).

The substances in the serum which cause the dissolution of the red corpuscles are called "hæmolysins"; the serum is "hæmolytic," the process is "hæmolysis."

It is possible to produce sera which will dissolve other cells also. In the literature of the day one finds accounts of "leucolysins," sera which dissolve leucocytes; "nephrolysins," sera which dissolve kidney cells; "hepatolysins," sera which dissolve liver cells, etc.

In the same way there can be produced "hæmoagglutinins," etc.

"Precipitins' can be formed by inoculating one animal with the serum of another. "Coagulins" have been produced by inoculating one animal with the milk of another.

An animal is said to be "immunized" when it is treated with inoculations, whether of toxins, bacteria, red blood corpuscles, serum, or any other material, and the animal thus treated is spoken of as an "immune" animal. Thus a guinea-pig can be immunized against cholera vibrios, the guinea-pig's serum dissolving the vibrios. The guinea-pig can be immunized against typhoid bacilli, the serum agglutinating the bacilli. A rabbit can be immunized against human serum, the serum of the immune rabbit producing a precipitate in human serum. The goat can be immunized against the red blood corpuscles of the ox, the serum of the immune goat producing lysis of the red blood corpuscles of the ox, and so on.

In all such cases the serum of the immune animal becomes toxic for the species from which material was taken for inoculation. In the last case mentioned the serum of the immune goat is toxic for oxen. A serum which is toxic for the cells of another animal is called a "cytotoxin," though of course cytotoxin includes all other cell toxins also. The general name for the process of dissolution of cells is "cytolysis." Sera which cause the dissolution are "cytolysins," though of course any other substance which produces solution of cells is a cytolysin also. All of these reaction products in the serum of an immunized animal appear to have their energies especially directed against material like that with which the animal was inoculated; hence these reaction products are termed "antibodies."

Much information concerning the process of cytolysis, especially of hæmolysis, has been furnished in recent years by the investigations of Ehrlich and his pupils (see particularly the works of Ehrlich, Morgenroth, and Sachs). In their first researches Ehrlich and Morgenroth worked with the serum of a goat which had been immunized against the red blood corpuscles of a sheep, the goat's serum, therefore, dissolving the red blood corpuscles of the sheep. Subsequently, a great number of different combinations was employed. Ehrlich and Morgenroth corroborated Pfeiffer and Bordet in their conclusion that there are two substances in the serum concerned in producing cytolysis. One of these substances appeared as the result of inoculating or immunizing the animal. It was, therefore, called the "immune body."

Ehrlich and Morgenroth found that the immune body in the serum of the immunized goat readily unites with the red blood corpuscles of sheep. This immune body by itself, however, even when united to the corpuscles of the sheep, produced no change in them. The lysis of the red blood corpuscles resulted only when a second constituent of the serum was added. This substance was, therefore, called "complement," because it completed the action of the immune body.

The immune body was a new constituent of the goat's serum which first appeared after the goat had been inoculated with red blood corpuscles of the sheep. The immune body was quite a stable body with marked resistance to heat, light, and chemical reagents. It possessed the property of uniting with the red blood corpuscles of sheep. This union occurred quickly and even at low temperatures. The immune body had an affinity for the red blood corpuscles of sheep which was specific. This specificity, it was found, was of a chemical nature, as described above. The distinguishing feature of immune body was that when immune body, complement, and red blood corpuscles of sheep were brought together at a suitable temperature (about 37° C.) lysis of the red blood corpuscles resulted.

The complement was a normal constituent of the goat's serum, being neither increased nor diminished by the inoculations with corpuscles of sheep. The complement occurred in normal goats which had not been inoculated. It was also found in the serum of normal sheep and of other normal animals. Complement was a very unstable body with little resistance to heat, light, and chemical reagents. It could not be made to unite directly with red blood corpuscles. Only after the immune body had united with the sheep's corpuscles was it possible to bring about union of the complement, and even then union would not occur at low temperatures. The distinguishing feature of complement was that when complement, immune body, and the red blood corpuscles of sheep were brought together at a suitable temperature, lysis of the red blood corpuscles was produced.

Ehrlich was able to explain in terms of the side-chain theory the various phenomena manifested by the antibodies mentioned in the outline just given. He concluded that there must be several forms of side chain. The simplest form is a side chain whose only function is to unite with the foodstuff, thus bringing the food within reach of the central group of the cell. This form of side chain has been considered at length in describing the side-chain theory of assimilation and of antitoxin immunity.

A second form of side chain is so constructed that it not only unites with the foodstuff but also exerts a cer-

tain digestive or enzyme-like action upon it before the central group comes into play. This type of side chain contains two chemical groups: the haptophorous group and the zymophorous or enzyme-like group.

If any inoculated material happens to have an affinity for an haptophorous group of such side chains union occurs. The side chain is thrown off from the cell, new formation, overproduction and setting free of side chains follow according to the requirements of the side-chain theory. The side chains set free in the circulation being identical with the pre-existing side chain, are characterized by having both an haptophorous and a zymophorous group. When such a free side chain or antibody encounters material for which it has an affinity, in the first place, union occurs between the mutually attractive groups, and then the zymophorous group of the side chain exerts its action upon the material.

Agglutinins and coagulins are to be classed as free side chains or antibodies of this order, for they not only unite with substances for which they have an affinity, but also produce definite changes in those substances.

A third type of side chain remains to be considered. Here the side chain possesses both a haptophorous group with affinity for some foodstuff and also a second binding group with affinity for an enzyme-like substance in the circulation. Suitable food molecules unite with the haptophorous group of these side chains, whereupon the second binding group picks up the enzyme-like substance for which it has an affinity, and changes are brought about in the food by this enzyme-like substance.

If inoculated material happens to have an affinity for the haptophorous group of such side chains, union occurs, the side chains are thrown off, new formation and overproduction follow, and the new side chains are set free in the circulation. The free side chains or antibodies, being like the pre-existing side chains, are capable of uniting with two substances: first, the inoculated material; the other, the enzyme-like substance in the serum of the immune animal.

If such a free side chain or antibody encounters material for which it has an affinity, union occurs between the mutually attractive groups, and then the second binding group of the antibody picks up from the circulation the enzyme-like substance, which in turn exerts its action through the antibody upon the inoculated material.

This is the mechanism of cytolysis. The inoculated cells have led to the new formation, overproduction, and setting free in the circulation of certain side chains. These free side chains or antibodies are the immune bodies in the serum of the immunized animal. The enzyme-like substance normally present in the serum of the animal is the complement. If some cells of the sort inoculated are treated with serum of the immunized animal under proper conditions the immune body unites with the cells, the complement unites with the immune body, and lysis of the cells results.

It is not yet definitely settled whether precipitins are antibodies of the second order like agglutinins, or of the third order like cytolysins. Recent investigations indicate that the precipitins are antibodies of the third order.

These three types of side chain suffice to account for all the reaction products thus far investigated. There are many features of the side-chain theory which cannot be entered into in this review. In general it may be said that the chemist's point of view has been adhered to by Ehrlich in dealing with all the complicated phenomena met with in studies in immunity. From what has been said it is evident that the prerequisites of antibody formation are few—a substance inoculated into an animal must possess a chemical group (the haptophorous group) which will unite with the side chain of some cell of the animal. If the cell is not injured and if the inoculated substance is not removed by digestion by the central group, conditions are favorable for antibody formation.

Several other antibodies are known in addition to those already mentioned. By inoculating an animal with ferments it has been possible to produce "antiferments" which are of the same type as antitoxins. By inoculating with a serum rich in agglutinins or coagulins it has been possible to produce antibodies which prevent the action of the agglutinin or coagulin. These substances are termed "antiagglutinins" or "anticoagulins." They are really "anti-antibodies." It has also been possible to produce substances which prevent the action of the complement, *i.e.*, "anticomplements" and substances which prevent the action of the immune body, *i.e.*, "anti-immune bodies."

Many of the substances mentioned above, such as agglutinins, cytolysins, anticomplements, etc., have been found in the serum of many normal animals. Such normal antibodies can be readily accounted for as free side chains.

It has been found that the physical and chemical properties of the immune body and of the complement are subject to quite wide variations, and also that there are great numbers of different immune bodies and complements in the serum of any one animal.

Evidence goes to show that the complement arises from cells in the circulation, probably leucocytes. It has been found also that a certain quite definite chemical substance, lecithin, can act as complement.

It has been possible to apply nearly all of the deductions made from studies with hæmolytic sera to the various infectious diseases and to various animal and vegetable poisons.

There seems to be no fundamental antagonism between the side-chain theory of Ehrlich and Metschnikoff's phagocytic theory of immunity.

In concluding it will be well to give a list of other terms used in the literature of immunity. It has been stated that the complement is the unstable enzyme-like material normally found in certain animals. This material is also spoken of as "addiment," "cytase," or "alexin."

The immune body is also called "amboceptor" (that is, receptor with two binding groups), "substance sensibilisatrice," "präparator," "fixateur," "copula," "desmon," "intermediary body," or "Hilfskörper." The anti-immune bodies are also spoken of as "anti-amboceptors."

Harry T. Marshall.

SIDEROSCOPE.—The use of a magnetic needle for detecting foreign magnetic bodies in the eye was first advocated in 1880 by Thomas R. Pooley, of New York, but the suggestion did not attract much attention until the subject was taken up by Edward Asmus in 1894, who utilized the principle in an instrument which he called a *sideroscope*. Since then several modifications of the instrument have been brought forward, but for practical purposes Hirschberg's model is probably the best. This consists essentially of a magnetic needle suspended by a vertical thread, to which is attached a small mirror. The deflections of the needle produced by a foreign body in the eye of a patient is indicated by a beam of light from a lamp which is reflected by the mirror upon a graduated scale. The chief disadvantage of the instrument lies in its instability, for which reason it can be used with success only in places free from vibration. While it is quite delicate, many ophthalmologists claim that it is entirely unnecessary where Haab's giant magnet and an *x*-ray apparatus are available. *Frederick Herman Verhoeff.*

SIDEROSIS.—Ordinarily this term is used to designate the pigmentation of the lungs produced by the inhalation of any sort of metallic dust, but strictly it should refer to the deposition of iron pigment alone in any of the tissues of the body. A full account of siderosis used in the former sense will be found under *Pneumokoniosis*. True siderosis is usually due to the breaking down of the red corpuscles of the blood, and is best spoken of as *hæmatogenous siderosis*. This takes place to some extent in many chronic diseases, but especially in pernicious anæmia, and involves particularly the liver, spleen, bone marrow, and kidneys. It also occurs as the result of the disintegration of hemorrhages, as is the case, for instance, in chronic passive congestion of the lungs, and not infrequently in tumors. For this reason tumors should always be subjected to the test for iron before a conclusion is drawn as to their melanotic nature.

A condition of considerable importance in ophthalmology is *siderosis bulbi*, which is due to the presence of iron within the eye that has lodged there as the result of an injury. This is of little importance where the severity of the injury has been so great as to destroy sight at once, or where it has given rise to panophthalmitis, but not infrequently a small bit of iron may penetrate the globe without producing much damage or setting up serious inflammatory disturbances. Under these conditions the iron gradually disintegrates, and minute particles of iron rust are carried to various parts of the eye, especially the iris and retina, which take on a brownish-red color. In the specimens examined by the writer, the iron has been deposited in the form of small pigment granules, which are always found within cells. They are not confined to any special type of cell, though the connective-tissue cells of the iris stroma and the pigment cells of the retina, including those over the ciliary body and iris, seem to take them up most freely. Both the circular and radial muscle fibres of the iris, however, take them up, as do also to some extent the ganglion cells and nuclear bodies of the retina. The connective-tissue cells about the canal of Schlemm, as might be expected, are markedly involved. The cornea does not seem to be involved unless iron particles have lodged in its stroma, in which case the corneal corpuscles may become packed with iron pigment to such an extent that the cornea assumes a rust color. The epithelial cells beneath the lens capsule may also take up the pigment. The writer has never seen the choroid involved, nor the optic nerve, though the disc may be pigmented. The iron pigmentation of the retina leads to atrophy of the latter, as is manifested subjectively by night blindness, contraction of the visual field, and finally total blindness. Siderosis bulbi, however, does not always result when a particle of iron remains in the eye, because in many cases the foreign body is thoroughly encapsulated in connective tissue. In one of the writer's specimens the eye became intensely pigmented within three years after the injury, and in this case the foreign body was not encapsulated but was simply adherent to the retina, where it had sunk down and come in contact with it below. Siderosis bulbi can also be hæmatogenous in origin, sometimes resulting from an intraocular hemorrhage. In order to distinguish this from the siderosis dependent upon the disintegration of a foreign body, von Hippel applies the term *xenogenous siderosis* to the latter. *Siderosis conjunctivæ* may be produced by the long-continued use of sulphate of iron as a collyrium. The best differential method of staining histological sections for iron is to place them for six hours in a two-per-cent. solution of equal parts of potassium ferro- and ferricyanide, and then in acid alcohol for six hours. In this way both the ferrous and ferric salts give a beautiful blue reaction.

Frederick Herman Verhoeff.

SIDONAL, piperazine quinate, is a compound designed to combine the solvent power of piperazine for uric acid with the power of quinic acid to restrain uric-acid formation. Blumenthal and Levin found the compound to reduce the excretion of uric acid and to increase that of hippuric acid. Bardet, in three cases of gout, administered 3–5 gm. (gr. xlv.–lxxv.) a day, and tested the urine twice a month; there was a moderate but steady decrease in uric acid. Salfeld speaks highly of the remedy in gout, but obtained no effect in a case of acute articular rheumatism. F. F. Ward, of New York, applied the remedy in various cases with gouty, rheumatic, or neuralgic pains. In those cases with excessive secretion of uric acid there was marked amelioration, and in all other cases no effect. The dose of sidonal is 1 gm. (gr. xv.) several times a day. Its combination with lithium citrate is called "urosin."

"New sidonal" is described by Huber and Lichtenstein as quinic anhydride. It is given for gout in dosage of 2.5 gm. (gr. xl.) a day.

W. A. Bastedo.

SILICOSIS.—The term applied to the pulmonary condition arising from the inhalation of *quartz dust.* The histological changes and the symptomatology are identical with those of *chalicosis*, or "marble-cutter's lung." Silicosis is of much less frequent occurrence than the latter condition, and is seen chiefly in those parts of the country in which mining, crushing, and stamping of quartz ores are carried on ("miner's consumption"). In granite-workers silicic dust is deposited in the lungs in association with the dust of the other constituents of the stone. The condition of silicosis may also be seen in the lungs of individuals exposed to silicic dust, in such occupations as the crushing of flints in glass manufacture, polishing and cutting of rock crystal, agate, etc. It has been said that the symptoms of silicosis develop more rapidly than those of chalicosis, and as a rule are more severe, for the reason that the quartz dust is more irritating and less capable of solution by the body juices than is dust composed of calcium carbonate. The clinical picture of silicosis is that of a fibroid pneumonia, and, as secondary tuberculosis is of very frequent occurrence, the final course of the disease is usually that of a fibroid tuberculosis. (See also *Pneumonokoniosis*).

Aldred Scott Warthin.

SILVER.—I. General Medicinal Properties of Compounds of Silver.—In medicinal dosage the most important effect that follows persistent internal medication with silver is the tendency to a bluish-black discoloration of the skin and mucous membranes. This staining shows first on the mucous membranes, so that by inspection of the inner surfaces of the lips and of the fauces, during a course of medication by silver, and by stoppage of the medicine upon the first beginning of a bluish discoloration of those parts, no serious risk of staining of the skin need be incurred. As a rule, efficient dosage with silver can be maintained for from one to three months before coloration begins. In overdosage silver is a constitutional poison, impairing nutrition generally, and deranging the nervous system particularly. Therapeutically, impregnation of the system with silver tends to oppose, albeit feebly, the onward march of certain diseases of the nervous system, such as epilepsy and tabes dorsalis. But in the more intractable of these diseases, such as tabes, the influence is so slight as to be of no value—if, indeed, it exist at all—and in epilepsy other remedies are far more potent. The use of silver for constitutional effect is, therefore, in modern practice, quite abandoned.

Locally, the effects of silver compounds differ with the individual preparations according to their solubility, and will be described in connection with the several compounds themselves.

II. The Compounds of Silver Used in Medicine.—These comprise the *oxide, iodide,* and *nitrate.* The *cyanide* is also official in the United States Pharmacopœia, but for pharmaceutical purpose only.

Silver Oxide: Ag_2O. Silver oxide is official in the United States Pharmacopœia as *Argenti Oxidum*, Silver Oxide. It is a heavy, dark brownish-black powder, odorless, but of a metallic taste. It is liable to undergo reduction upon exposure to light. It is very slightly soluble in water and is insoluble in alcohol. It should be kept in dark amber-colored bottles, protected from the light. This oxide readily yields its oxygen in presence of oxidizable matter, and hence should not be triturated with any such material. It dissolves in water of ammonia. From its comparative insolubility this compound has little local effect, but when swallowed, probably through chemical conversion, it is capable of absorption, and exerts the constitutional effects of silver such as they are. In such operation the oxide is thought to be less prone to discolor the skin than the nitrate, but it is certainly not wholly innocent of this tendency. Upon the stomach and bowels silver oxide has quite a marked potency to allay irritability, tending to quell vomiting, even in such complaints as ulcer and cancer of the stomach, and to control diarrhœa when arising as a

reflex of nervous irritation. The principal employment of the medicine is in such disorders of the digestive apparatus. The average dose is about 0.06 gm. (gr. i.), best given in powder or capsule. The pill form is bad, because of the deoxidation of the compound by the organic matter of the excipient, which reaction may even be attended by explosion. Gum arabic is recommended as the least objectionable excipient.

Silver Iodide: AgI. The salt is official in the United States Pharmacopœia as *Argenti Iodidum*, Silver Iodide. It is a heavy, light yellow powder, which, when pure, is not affected by light other than to change color to a greenish-yellow. It is insoluble in water or alcohol. It should be kept in dark, amber-colored bottles, protected from the light. Silver iodide is, medicinally, substantially a duplicate of the oxide, and may be used for the same purposes and in the same dose.

Silver Nitrate: $AgNO_3$. This, by far the most important compound of silver, is official in the United States Pharmacopœia in three conditions, namely, in crystals, in cylindrical sticks moulded by fusion, and in similar sticks in admixture with equal parts of potassium nitrate.

Argenti Nitras, Silver Nitrate. This title signifies the salt in crystals. These crystals are small, transparent rhombs, originally colorless, but gradually becoming grayish-black on exposure to light and air. They are odorless, but have a strong metallic taste. They dissolve freely in water, in twenty-six parts of cold alcohol, and in five parts of boiling alcohol. When heated to about 200° C. (392° F.), the crystals fuse to a faintly yellow liquid, which, on cooling, congeals to a purely white, crystalline mass. Silver nitrate should be kept in dark amber-colored vials protected from the light. These crystals constitute the purest form of the nitrate, and are used for internal giving or for the making of solutions.

Argenti Nitras Fusus, Moulded Silver Nitrate, "Fused Nitrate of Silver," "Lunar Caustic." The crystals are melted by heat, and the fused salt poured into moulds where it sets on cooling. But inasmuch as the pure nitrate is, when fused, inconveniently brittle, the Pharmacopœia provides for a trifling admixture of silver chloride, which is a tough compound. To this end about four per cent. of hydrochloric acid is added to the melted crystals, whereby a small portion of the nitrate is converted into chloride. Reaction having ceased, the mixed mass is ready for moulding. Lunar caustic is cast in narrow cylindrical sticks, which are hard, brittle, and, when freshly made, white in color. As commonly found, however, they are gray, or even blackish, through chemical reaction with matters present in the atmosphere. Fused nitrate of silver should be used only for its legitimate purpose, that of external application. The sticks should be kept protected from the light.

Argenti Nitras Dilutus, Diluted Silver Nitrate. Silver nitrate and potassium nitrate, the latter in double the quantity of the former, are melted together by heat and the fused mass moulded into sticks like those of the simple moulded silver nitrate. The sticks of the diluted nitrate resemble those of the pure nitrate except that they are granular rather than fibrous in texture. They are commonly called "mitigated sticks" of silver nitrate. They should be kept protected from the light. The sticks dissolve freely in water and possess the same properties as the undiluted lunar caustic, only in milder degree. They are used only for local application.

Silver nitrate differs from the oxide and iodide in the essential particular of free solubility, on which property depend the most valuable medicinal virtues of the salt. The most important reactions of the nitrate are that its solutions are precipitated by soluble chlorides to form the very insoluble salt, silver chloride. This reaction is one of the most delicate in chemistry, and since traces of chlorides are present in almost all natural waters, the use of distilled water is necessary for solutions of silver nitrate, if a clear, bright solution be desired. Silver nitrate also reacts on organic matter generally, suffering decomposition, and forming, with the organic substance, compounds insoluble and acquiring a rusty brownish-black color under the action of light. Hence sticks of lunar caustic grow gray and black on the surface by keeping, by reaction with the organic dust of the atmosphere, and solutions of silver nitrate deposit a fine black sediment, and stain textile fabrics and skin. The stain on the skin, if recent, can be removed fairly well by rubbing with a moistened lump of potassium cyanide, and washing—always remembering the very irritant and poisonous character of such cyanide. But if the stain be old, and fixed by exposure to sunlight, the cyanide fails, and the following means may be resorted to: Moisten the stains, drop on them a little tincture of iodine, and then wash in a six-per-cent. solution of sodium hyposulphite. Or, very efficient, mix in a saucer a few bits of iodine with a little water of ammonia; rub the stains quickly with the resulting preparation, and immediately wash both skin and saucer while they are still wet. This latter precaution is necessary, since the compound of iodine and nitrogen produced by the mixture of chemicals spontaneously explodes upon slight agitation when dry. Other reactions of silver nitrate are its precipitation by sulphuric, hydrosulphuric, phosphoric, hydrochloric, and tartaric acids and their salts; by the alkalies and their carbonates, lime water and the vegetable astringents, and arsenical and albuminous solutions.

Silver nitrate is an irritant astringent, with also the peculiar specific effects of silver compounds already detailed, viz., the allaying of gastric irritability, and the induction of certain constitutional control over nervous disease. The local effects are the more important, and are as follows: The salt readily combines with albumin to make an insoluble compound, the albuminate of silver; hence, when in strong solution or in solid stick, its application to the surface of a mucous membrane or of granulation tissue produces a white streak of cauterization, which, by the insolubility of the compound formed, limits the action of the caustic to the production of such shallow slough. Concentrated applications to the skin speedily blacken the epidermis, and, more slowly, raise a blister. In solutions less than ten per cent. in strength the salt is hardly caustic, but acts only as an irritant astringent. When swallowed, quite small doses act locally like the oxide, while large produce irritant poisoning. Therapeutically, local applications of silver nitrate judiciously made have a marked tendency to promote absorption in such tissues as are capable of undergoing this process; to induce healing; to limit and abate the catarrhal process; to destroy skin parasites, though not very searchingly; and to neutralize the virulence of specifically noxious pus.

The medicinal uses of silver nitrate are such as may be deduced from the foregoing. Internally the medicine may be given, for constitutional or local effect, in doses of from 0.015 to 0.03 gm. (from about one-fourth to one-half grain) in pill or solution. In neither way of giving does the salt probably reach the stomach as nitrate; for, if in solution, a medicinal dose must almost certainly be decomposed in the swallowing, and, if in pill, be acted on similarly by the necessary organic matter of the excipient. To obviate this effect as far as possible in the case of pills, it is advised that bread-crumb be particularly avoided as an excipient, because of its containing a soluble chloride (common salt) as well as organic matter, and that some vegetable extract, or a dry powder made sticky by a minimum of gum, be selected. In any case the crystallized silver salt should alone be prescribed. Externally, silver nitrate may be used as a caustic, but only where a superficial effect is wanted, as for the destruction of the lining membrane of a cyst. The fused stick is in such cases used, its moistened surface being swept over the surface to be destroyed. More common is the application to promote absorption, as in case of exuberant granulation tissue or trachoma bodies; to determine healing, as in unhealthy ulcers; or to shorten and abate the course of a catarrh. For such purposes various strengths of the nitrate are used, from application of the pure or diluted sticks of lunar caustic to that of solutions of not more than the one-fifth of one per cent. strength. To determine absorption the stronger applications are necessary, to control catarrhs the weaker; but in all cases care should be taken not to overdo the matter, and, by too strong or too frequent application, actually to interfere through excess of irritation with healing or with resolution. In the case of catarrhs, moreover, the remedy should not be used at all until the second stage of the process is reached, as betokened by the establishment of the catarrhal secretion and abatement of the initial pain or sensitiveness. Then, too, the strength of the application should be adjusted to the different degrees of sensibility of the different mucous membranes; for while the comparatively insensitive membranes, such as those of the fauces or vagina, may take a five-per-cent. solution, or even stronger, hardly more than the one-tenth of this strength can be applied without undue irritation to the nasal passages or to the male urethra. When a very brief action is wanted, the application of silver may be followed immediately by one of a solution of common salt, which salt immediately precipitates all excess of nitrate as the insoluble, and therefore inert, compound, silver chloride.

Silver Cyanide: AgCN. This salt is official in the United States Pharmacopœia as *Argenti Cyanidum*, Silver Cyanide. This salt is an insoluble white powder, not used in medicine, and official only for the making, by the pharmacist, of diluted hydrocyanic acid.

Besides the foregoing, a number of unofficial preparations of silver deserve brief notice.

Silver Vitelline, Argyrol.—This remarkable compound has recently been prepared and proposed for medical use by Barnes and Hille, of Philadelphia (*Medical Record*, May 24th, 1902). A salt solution of vitelline, a derived proteid obtained from gliadin, is precipitated by silver nitrate. Such precipitate — silver vitelline — properly dried, appears as a dark-brown powder. The substance contains thirty per cent. of silver, about half the amount contained in silver nitrate, and is remarkable for being extremely soluble in water, while at the same time it does not precipitate albumin or sodium chloride, and is wholly unirritating. Its solution also penetrates albuminoid tissues very readily and thoroughly. Silver vitelline thus possesses all the desiderata for an ideal silver preparation, and has been used with great success as a local application in inflammations of the mucous membrane of the eye, ear, nose, vagina, urethra, and bladder. It is employed in aqueous solution ranging in strength from one-tenth of one per cent. to twenty-five per cent. and upward, according to the character and sensitiveness of the part. Even a ten-per-cent. solution applied as an injection in acute gonorrhœa produced no irritation (Christian).

Colloidal Silver (Soluble Silver, Collargol).—This is a bluish-green substance obtained by precipitating with silver nitrate a mixed solution of ferrous sulphate and sodium citrate. Collargol contains 97.2 per cent. of silver, dissolves in 25 parts of water forming a dark reddish-brown solution, and is easily decomposed. Its aqueous solution, on standing, deposits a small sediment of insoluble silver.

Collargol, introduced into the general circulation, has been declared by Credé and others to exercise a remarkable curative power over the conditions of general septic infection, whether by action on the micro-organisms themselves or on their toxins is not clear. At the same time the remedy is non-poisonous and, being rapidly eliminated after absorption, does not produce argyria. The only untoward effect observed has been a slight chill and rise of temperature, but even this is not seen if (using by intravenous injection) care is taken that the solution be free from sediment.

Collargol may be administered by inunction or by intravenous injection. For the latter method a carefully prepared, freshly made solution in distilled water is to be used, of a strength of one-half to one per cent. If a sediment forms, the supernatant liquor must be decanted. Of such a solution from half a fluidrachm to five fluidrachms may be injected directly into some superficial vein once or twice daily, or every two or three days. The more common method of administration, however, is by inunction. For this purpose a fifteen-per-cent. ointment is used, of which the quantity of from thirty to forty-five grains is rubbed thoroughly into the skin of the inner side of the arms or thighs, or of the back, from one to three times daily. Collargol ointment decomposes readily and should not be exposed to the air. An ointment should not be used that shows white crystals on the surface, or that fails to color the skin black on inunction. An ointment having the official sanction of Professor Credé is on the market under the title "Unguentum Credé." This ointment contains fifteen per cent. of collargol in a mixture of lard, wax, and benzoic ether.

Silver Sulphocarbolate, $C_6H_4(OH)SO_3Ag$. This compound occurs as a white crystalline powder soluble in water. It contains twenty-eight per cent. of silver. If exposed to light and air it decomposes spontaneously. It has been proposed as a substitute for silver nitrate because non-corrosive.

Silver Citrate: Itrol, $Ag_3C_6H_5O_7$. This compound is a fine, dry powder, without taste or smell, very slightly soluble in water. Its solution is immediately decomposed by organic matter. Like silver vitelline, it is non-irritant and penetrating, and has been proposed as a surgical disinfectant and for injection in gonorrhœa and cystitis. The strength of solution ranges from 1 to 4,000 to 1 to 8,000.

Silver Lactate: Actol, $AgC_3H_5O_3$. This compound is a white powder, without taste or smell, and soluble in from fifteen to twenty parts of water. It is a powerful germicide, and penetrates tissues, although decomposed by contact with the same. It is used as a surgical antiseptic, and strong, even saturated solutions may be applied to infected parts. Ordinary strengths are 1 to 1,000 or 2,000 parts of water.

Silver Quinaseptolate or *Oxy-chinolin-sulphonate: Argentol,* $C_9H_5N.OHSO_3Ag$. This compound is a yellow powder, slightly soluble only in water. In contact with septic substances it decomposes into oxyquinolin and metallic silver. It is used in surgery as a dusting powder, or applied in ointment (1 or 2 parts to 100 of ointment) or in solution, 1 to 3 parts to 1,000 of water.

Argentamin.—This name is given to a solution of silver phosphate (10 parts) in a ten-per-cent. aqueous solution of the organic base ethylendiamin. It is a clear fluid, strongly alkaline, and is devised to give a non-poisonous and unirritating antiseptic solution which shall not precipitate albumin. It is diluted one thousandfold for use.

Argonin.—This name is given to a body obtained by precipitating with alcohol a mixed solution of silver nitrate and a sodium compound of casein. Argonin is a white powder, neutral in reaction; insoluble in cold water, but readily soluble in warm or albuminous water. Solutions must be kept away from exposure to light. It has been used in gonorrhœa in solutions of from 1 to 7 parts in 1,000 of water.

Largin.—This name is given to an albumin compound of silver occurring as a gray powder soluble in 9 parts of water. Largin is powerfully germicidal while non-irritating, and is not precipitated by albumin or sodium chloride. It has been used in gonorrhœa in solutions ranging in strength from one-fourth to one and a half per cent.

Protargol.—This name is given to a silver albumose containing eight per cent. of silver. It is a yellow powder, freely soluble in water; unaffected by heat, albumin, or sodium chloride in weak solution, and wholly unirritating. It may be used with great freedom as a local application, being employed in solutions varying in strength from five to twenty-five per cent.

Edward Curtis.

SILVER, POISONING BY.—See *Argyria.*

SIROLIN is a ten-per-cent. syrup of thiocol. (See *Thiocol.*) *W. A. B.*

SITKA HOT SPRINGS.—Location on Baronoff Island, Alaska, sixteen miles south of Sitka. They are reached from Sitka by boats only. Four houses have been built at this place, three with bath-rooms attached. In 1860 a hospital for rheumatism and skin and blood diseases was opened by the Russian-American Company. The baths were found to be very beneficial in syphilitic affections. The Indians have resorted to the springs for many years. They are about thirty feet above the sea-level, and distant from salt water about fifty yards. The springs are four in number, but the rate of water flow is unknown. The temperature of the water is 120° F., and it is said to contain sulphur, iron, manganese, and chlorine. The weather in this region is generally clear during the summer months, with a temperature ranging from 60° to 80° F. The spring and fall seasons are rainy, and the winters cold and cloudy, the temperature varying from zero or a little below to 40° F. The spring season is considered preferable for visiting the springs. Other hot springs are located on Chickagoff Island, about eighty miles from Sitka, but as yet no name has been given to them. Little is known concerning them, except that they have some reputation among the Indians in the same diseases as those mentioned above. Within half a mile of Sitka, on a road called Davis Avenue, there is an iron spring flowing from a rock. It has not been analyzed, but it was formerly esteemed by the Russians for its tonic properties.

James K. Crook.

SKAGG'S HOT SPRINGS.—Sonoma County, California.

Post-Office.—Skagg's Springs. Hotel and cottages.

Access.—From Tiburon Ferry, San Francisco, 7:40 A.M. and 3:30 P.M.; arrival at Geyserville, where connection is made with stage for springs at 11 A.M. and 7 P.M. Connections from Sacramento by Carquinez and Santa Rosa Railroad to Santa Rosa, thence viâ San Francisco and Northern Pacific Railroad to Geyserville.

Skagg's Hot Springs are pleasantly located in the Coast Range Mountains, in a picturesque spot, nine miles west of Geyserville and twenty miles east of the coast. The surrounding mountains are clothed with every variety of California verdure, and they abound with trout streams. Many varieties of game are also found, including bear, deer, grouse, and quail. We are informed that a new road from the springs to the coast has recently been constructed, making accessible the Gualalla River, a widely celebrated trout-fishing stream. The springs, four in number, yield fifteen gallons per minute, the water having a temperature of about 120° to 140° F., and a somewhat pungent, agreeably alkaline taste. Excellent bathing facilities have been provided. Analyses have been made by Prof. Eugene W. Hilgard and Dr. Winslow Anderson, which show no material difference in their results. That of Professor Hilgard is as follows:

One United States gallon contains (solids): Sodium chloride, gr. 5.90; sodium bicarbonate, gr. 161.27; sodium biborate, gr. 26.47; magnesium carbonate, gr. 11.11; calcium carbonate, gr. 2.20; silica, gr. 7.02; sodium iodide, potassium chloride, potassium sulphate, potassium iodide, magnesium sulphate, ferrous carbonate, barium carbonate, lithium carbonate, strontium carbonate, alumina, and organic matter, very small quantities. Total solids, 214.80 grains.

Free carbonic-acid gas, 124 cubic inches.

The waters here are very useful in rheumatism, neuralgia, sciatica, etc., as well as in affections involving the bladder and kidneys. They are highly recommended by medical men on the coast, and the proprietor has determined to keep the resort open all the year.

James K. Crook.

SKIN, ANATOMY OF.—See The Appendix.

SKIN, FUNCTIONS OF.—The functions of the skin may be conveniently classified as follows:

I. Protective; II. Excretory; III. Temperature-regulating; IV. Absorptive; V. Sensory.

I. Protective Functions of the Skin.—As an outer covering of the body, the skin protects the deeper parts (*a*) from evaporation, (*b*) from excessive wear and tear, and (*c*) from mechanical violence. The outer layer of the skin (epidermis) has a structure like horn, and forms a shell over the entire body. The deeper layers of the skin and the subjacent tissues and organs are constantly bathed with lymph, which must be renewed from the blood, and if it were not for the horny covering of the epidermis the lymph would evaporate from the surface more rapidly than it could be renewed, and the nerve endings and other delicate structures in the deeper layers would be thrown out of function. The secretion of the sebaceous glands (oil glands), by keeping the epidermis slightly permeated with oil, is of material aid in preventing this evaporation. It is very important that some water should be evaporated from the surface of the skin, but this is provided for through the sweat glands, whose function will be considered in Sections II. and III.

The epidermis of the skin is obviously a great protection against wear and tear, which the softer parts, underneath, would not stand. It varies in thickness in different parts of the body, being thickest in those parts which are most used in such a manner as to wear them away; for example, the palms of the hands and the soles of the feet. In some places it is reinforced by nails and by hair, which are in structure simply modified epidermis. As the outer layer of epidermis is worn off it is replaced from the deeper layers.

Lying immediately under the epidermis comes the dermis (cutis vera, true skin), and beneath this is the subcutaneous connective tissue (superficial fascia). In this connective tissue there is a large amount of fat in an ordinarily well-nourished individual. This fat, in proper quantity, not only covers the angularity of muscles and joints, thus giving beauty to the figure, but it forms a protective pad, which breaks the force of blows, prevents the penetration of foreign bodies (as in puncture wounds and cuts) to important deeper-lying structures (arteries, nerves, etc.), and otherwise adds to the protective function of the skin. As a protection against mechanical violence the hair often plays an important part, as on the scalp.

II. The Skin as an Excretory Organ.—The chief excretions of the skin are the sebum (oil) and the sweat. In many of the lower animals the skin is an important respiratory organ—a frog will live for days with his respiratory centre destroyed—and this function is not entirely lost in man. It is certain that some carbon dioxide is given off by the skin of man, and it is probable that a very slight amount of oxygen may be taken in, but in either case the amount is so small that for practical purposes it may be disregarded.

The sebum (oil) is secreted by the sebaceous glands, which are found all over the skin with the exception of the palms of the hands and the soles of the feet. Where hairs occur the sebaceous glands commonly empty into the hair follicles. One of the chief functions of the sebum is to keep both the hair and the skin from becoming harsh and brittle.

The sweat glands are the most important excretory organs of the skin, but it is a common error to suppose that *in health* they play a *prominent part* in the elimination of waste products, such as urea and allied substances. Chemical analysis shows that the sweat contains about 98.8 parts of water and 1.2 parts of solids. Of these solids common salt (sodium chloride) is the most abundant—the salty taste of sweat is probably known to every one. By weight there are only 8 parts of urea to 10,000 of sweat, and sometimes it is present merely in traces; while the amount of urea in urine is about two