

Bacteria of the Skin

by

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The necessary requirements for the growth of bacteria being considered, it readily appealed to the writer that the surface of the human body furnished all of these necessary requirements. The excretions and exfoliated epithelium of the skin, the warmth of the body and protection from sunlight and fresh air by the clothing afford very favorable conditions for the growth of these organisms. To first find what bacteria are on the skin under varying conditions, their resistance to disinfectants and then determine their importance in surgical work and hygiene, this thesis is attempted.

Bacteria are commonly described as existing everywhere. Ever present in air, dust, soil and water in greater or less numbers. In sewage, in the intestines and, in uncleanly or unhealthy persons especially, on the skin and between the teeth, various species may always be found. In his examination of water from various sources, Miquel found that "wash water" from the floating laundries of the seine contained more bacteria than water from any other source, even than water in the Paris sewers. His enumeration gave twenty six million germs per cubic centimeter. Another investigator, Hohein found that sterilized woven goods worn next to the skin of the upper arm was attended with the following results,

Linen goods at end of one day 28 organisms, 2 days 4180.

Cotton goods at end of one day 105 organisms, 2 days 1870.

Woolen goods at end of one day 606 organisms, 2 days 6799.

When the material had been in contact with the skin for four days the colonies which had developed were so numerous that they could not be counted.

Students of medicine recognize bacteria as very important in causing disease. The fact that bacteria possess no chlorophyll and are not able to form plant food, makes it necessary for them to secure their nutri-

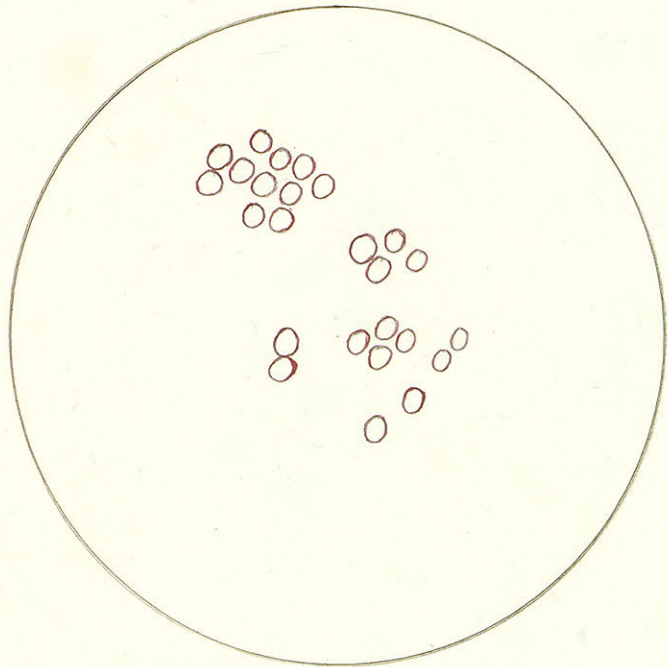
ment from pre-existing organic matter. While many find the necessary nutriment in the dead bodies of plants and animals, some flourish upon the living bodies of the other plants and animals in whom they may produce disease. It is thought that the phenomena of disease are largely due to the numerous waste products of the activities of bacteria which act as poisons to the host. Now when it is considered that bacteria are on the surface of the body, it is obvious that they are of very much importance in surgery for unless destroyed before operating they may enter the incision and produce undesirable results. The failures in the practice of aseptic surgery are generally due to the hands of the operator and his assistants, the instruments or the skin of the patient.

Local conditions become of great importance in surgery. The surgeon can seldom be certain of dealing with a perfectly aseptic wound and must rely to a large extent upon the power inherent in the fluids and tissues to prevent the development of bacteria. When lesions are produced in the internal viscera of animals by crushing and then bacteria are injected subcutaneously or into the blood, the bacteria lodge in the lesions and multiply.

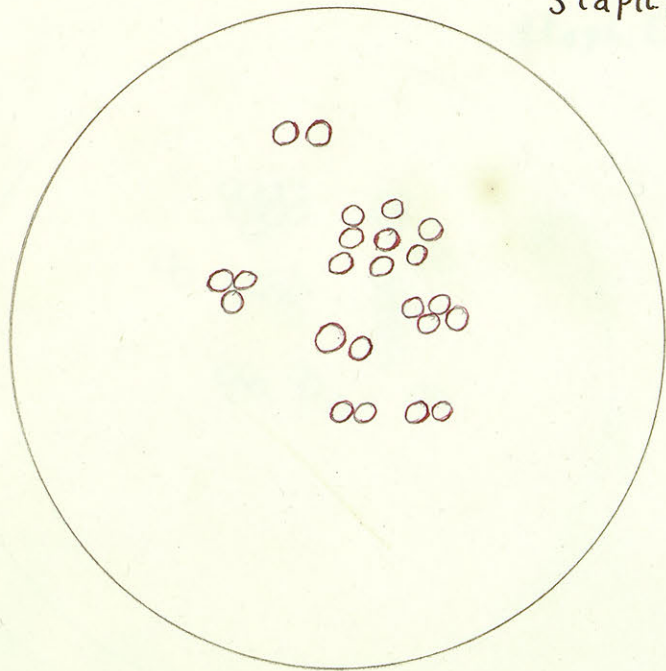
Again bacteria in surgery are recognized because, since they are the cause of a large number of diseases, in contagious diseases the physician is dealing with organisms which he cannot see and which may enter his own body and produce the disease.

The numerous solid tissues and organs of the body, the fluids circulating in the interior like the blood and lymph, and the cavities which have no connection with the outside world, are, in normal health, entirely free from bacteria. The skin is liable to have upon it, numerous bacteria, especially micrococci. It is asserted that it is impossible by any amount of cleaning to dislodge all the germs in the skin. So long as the bacteria

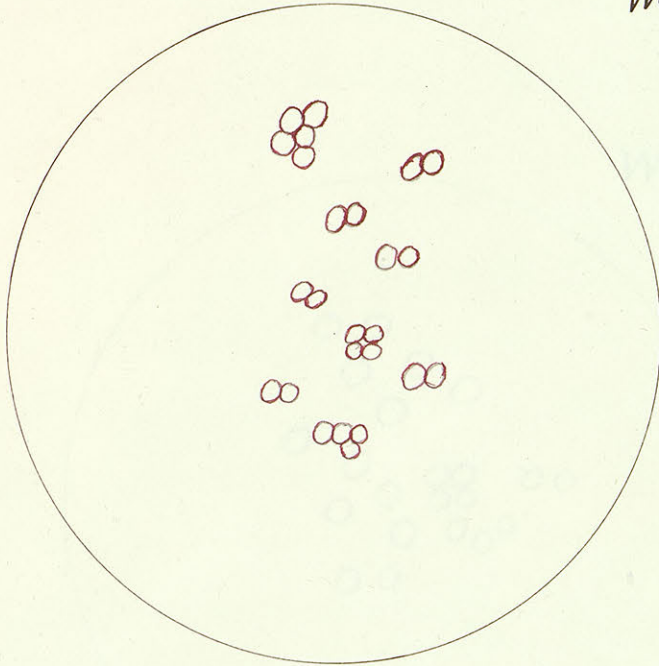
M. Pyogenes aureus.



Staph. Pyogenes Albus.



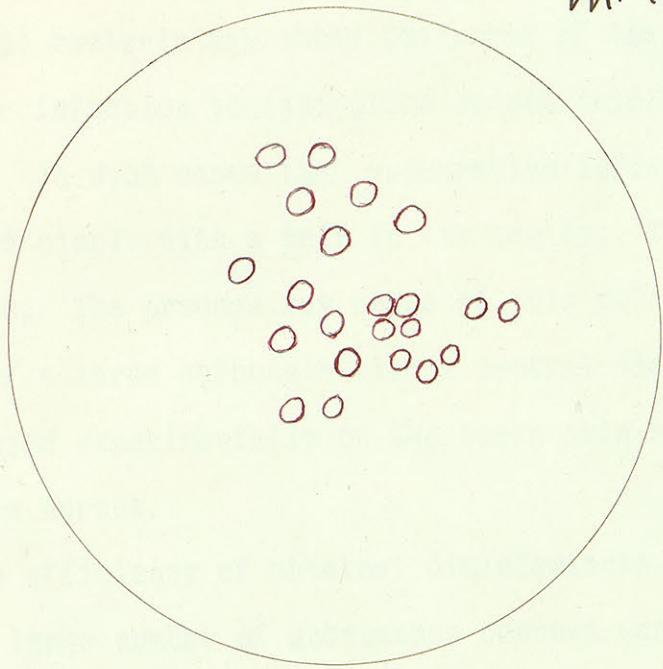
M. Luteus.



Staph. Epidermis Albus.



M. Rugosus.



remain upon the skin they do little harm but as soon as they enter the body tissue there ensues a struggle between the host and the invading organism.

Chief among the avenues by which bacteria may enter the body to produce disease is through some wound or other lesion. At the point when introduced the invading microbe usually produce a lesion as in the case of boils and carbuncles when pyogenic bacteria enter the skin. Some authorities assert that bacteria may enter the pores of the skin and again that it is possible for infection to take place around hair follicles through the unbroken skin. In such cases the suppurative inflammation first shows itself in a minute red pimple with a hair in the center. The pimple presently becomes a pustule. The process may cease at this point or it may be the commencement of a large carbuncle with a central stough. Such infection has been produced experimentally on the human skin by rubbing in cultures of staph. Pyogenes Aureus.

The efficiency of chemical disinfectants as ordinarily used is over rated. A large number of substances possess germicidal properties but, the majority are objectionable in that they are expensive, poisonous or so corrosive that damage may be done to tissues or articles with which they come in contact.

The determination of the antiseptic value of a material is a comparatively simple matter. The usual method is to obtain a virulent culture of the organism used as a test and inoculate into sterile bouillon containing a known quantity of the antiseptic. The process is repeated with varying strengths of the material until the smallest quantity of it capable of preventing growth is determined. This dilution may be considered the antiseptic value of the material in question for the organism used.

The determination of the disinfectant power of a substance is of

much greater problem and the method used must be altered more or less to suit the properties of the substance under test.

Several methods are employed,

Sternberg's method - To a measured quantity of a virulent bouillon culture of a test organism is added a known quantity of the substance to be tested. After varying lengths of time inoculations are made from this mixture into culture media preferably bouillon and growth watched for under suitable conditions as to temperature etc. The shortest exposure of the test organisms to the smallest quantity of the substance is taken as the germicidal value of that substance for the organism used. Boer, using this method made determinations from which the following table was found.

Organism Cultures in bouillon 24 hrs old exposure two hours.

	HCl	Na OH	Chl. of gold & sodium	silver nitrate	Carbolic acid
Anthrax B	1:1100	1:450	1:8000	1:20000	1:300
Diphtheria B	1:700	1:300	1:1000	1:2500	1:300
Glanders B	1:200	1:150	1:400	1:4000	1:300
Typhoid B	1:300	1:190	1:500	1:4000	1:200
Cholera B	1:1350	1:150	1:1000	1:4000	1:400

Kock's method - Small pieces of sterile silk thread are soaked for some time in a bouillon culture of the test organisms. They are removed, partially dried and then placed in a solution of known strength of the substance being tested and exposed for a definite length of time. The thread is removed, washed carefully in sterile water, planted in bouillon and growth watched, as in other methods the greatest dilution of the germicide that will kill the test organism in the shortest time, is taken as the germicidal value of that substance for the organism used.

It has been shown that bacteria are present on the surface of the

body in contact with the air. The foregoing methods of determining germicidal values have had to do with organisms artificially grown. Now the problem to determine the resistance to disinfectants of organisms living on the body is the major part of this work.

Original tests.

Before each test, hands were washed twelve minutes in warm soap and water. Then held in the solutions for the several periods and rinsed in sterile water. Then some epithelium was removed and inoculated into sterile bouillon. The knife used was kept sterile.

First as a check a culture was made from the epithelium after washing the hands and the organism isolated and named.

With corrosive sublimate 1 - 1000 solution.

Test 1. hand held in solution 1 min.

Test 2 hand held in solution 3 min.

Test 3 hand held in solution 5 min.

With corrosive sublimate 1 - 2000 solution

Test 1. hand held in solution 1 min.

Test 2 hand held in solution 3 min

Test 3 hand held in solution 5 min.

Test 4 hand held in solution 10 min.

With carbolic acid 7% solution.

Test 1 hand held in solution 1/2 min.

Test 2 hand held in solution 1 min.

Test 3 hand held in solution 2 min.

With carbolic acid 5% solution.

Test 1 Hand held in solution 1/2 min.

Test 2 Hand held in solution 1 min.

Test 3 Hand held in solution 3 min.

Test 4 Hand held in solution 5 min.

With carbolic acid 3% solution.

Test 1 Hand held in solution 1 min.

Test 2 Hand held in solution 3 min.

Test 3 Hand held in solution 5 min.

Test 4 Hand held in solution 10 min.

With carbolic acid 1% solution

Test 1 Hand held in solution 1 min.

Test 2 Hand held in solution 3 min.

Test 3 Hand held in solution 5 min.

Test 4 Hand held in solution 10 min.

With K. Permanganate 5% solution

Test 1 Hand held in solution 1 min.

Test 2 Hand held in solution 3 min.

Test 3 Hand held in solution 5 min.

(Hands were decolorized with Oxalic acid solution and then rinsed in boiled water.)

Tests for difference of effect of disinfectants on the skin organisms. The marks X represent the times used for tests with each disinfectant. The marks + indicate the lack of destruction of bacteria with growth on agar plates. The marks(-) indicate destruction of bacteria with no growth on agar plates.

Time in min.	1/2	1	2	3	5	10
1 - 1000		-		+	+	
Corrosive sublimate		X		X	X	
No of colonies				1	1	

Time in min.	1/2	1	2	3	5	10	
No of species				1*	1*		* M. Pyogenes Aureus.
Cor. Sublimate 1-2000		+		-	+	-	
		x		x	x	x	
No of colonies		500			300		
No of species		1			1		
7% solution carbolic acid							
		+	-	+			
		x	x	x			
No of colonies		45		230			
No of species		1		1			
5% carbolic acid		+	-		-	+	
		x	x		x	x	
No of colonies		90			8		
No of species		1*			1*		M. Pyogenes Aureus.
3% carbolic acid			+	+	+	+	
			x		x	x	
No of colonies			70		111	75	270
No of species			1		1	1	1
1% carbolic acid			+		+	+	+
			x		x	x	x
No of colonies			98		77	220	270
No of species			1		1	1	1
5% K. Permanganate			+		+	+	
			x		x	x	
No of colonies			78		46	38	
No of species			1		1	1	

Disinfection of the abdomen as a field.

Washed abdomen of patient with warm water and green soap. With sterile knife(boiled) removed some epithelium and inoculated into bouillon.

Washed off the field with 95% alcohol, then with 1-1000 solution of corrosive sublimate. Let this dry off then applied a 5% solution of Potassium permanganate, rubbing the field with the bands, then decolorizing both hands and field with a solution of Oxalic acid. (Hands had been put through same processes preceeding) Rinsed off the field with boiled water and with a sterile knife took a culture of epithelium.

Agar plate cultures.

After simply washing field, culture 120 colonies of M. Luteus.

After simply washing field and disinfecting 1 colony of M. Luteus.

Hair cultures.

Washed hands thoroughly with warm soap and water and pulled a few hairs from heads of three persons, an assistant with sterile forceps placed them in tubes of bouillon. After growing and naming the organisms the following were found;

- 1st culture contained organisms of M. Luteus and M. Pyogenes Aureus.
- 2nd culture contained organisms of Staph. Epidermis Albus & M. Pyogenes Aureus.
- 3rd culture contained organisms of M. Rugosus & M. Pyogenes Aureus.

Cultural characteristics.

M. Pyogenes Aureus. Isolated from hands a hair.

Liquifies gelatin, saccate, film on surface, heavy yellow sediment.

Agar, colonies in thin layer on surface, pale yellow.

Milk coagulated.

Lit milk coagulated.

Potato - orange red growth - scanty.

Bouillon clouded, slight ppt.

No gas. non-motile. Appears in pairs, solitary and in irregular clumps.

M. Pyogenes Albus.

Isolated from skin of hands.

Liquifies gelatin, sediment light colored.

Agar - grayish white growth.

Potato-cream colored growth over surface

Lit. milk partly coagulated and ppt.

milk - no growth.

Bouillon clouded.

Staph. Epidermis albus.

Gelatin liquefaction saccate, turbid heavy white ppt.

Liquefaction slow.

Agar growth grayish white.

Potato - white growth.

Milk - coagulated slowly.

Lit. milk coagulated slowly and neutralized.

Bouillon clouded.

Isolated from hair.

M. Luteus. Isolated from hair and hands.

Round occurring in twos and fours.

In bouillon - clear, yellow sediment.

Agar - lemon colored growth over surface.

Potato - shiny, yellowish gray growth.

Gelatin - Beaded, liquified after several days.

Milk coagulated.

Lit. milk - coagulated and neutralized.

M. Rugosus. Isolated from hair.

Round cocci. single and non-motile.

Bouillon clear, slight sediment.

Agar - yellowish red growth.

Gelatin - liquifies stratiform.

Potato growth thick rough, yellowish red color.

Lit. milk, slowly neutralizing and coagulating.

Milk coagulated yellow masses on surface.

That there are bacteria on the skin of the body is proven by the fact, that, from the hands, staph. Pyogenes albus and staph pyogenes aureus, from the skin of the abdomen. M. Luteus, and from the hair of the head these three, M. Pugesus and Staph. Epidermis albus were isolated. Of these two are pathogenic, the pyogenic organisms found being important in rank among the pus producing bacteria. The organism, staph Epidermis albus said to be most common of skin organisms, is also more or less pathogenic, frequently causing skin abscesses.

In testing the resistance of bacteria on the hands to disinfectants in all cases but two, the species which grow on agar plates was the staph. pyogenes albus. While no one disinfectant gave positive results for all periods tried, several results show that the materials were fairly effective. Corrosive sublimate 1-1000 gave best results and probably is the best disinfectant of those tried in the experiment. In general it may be said that even under quite rigid antiseptic treatment, microorganisms of the skin will continue their existence. The organism M. Luteus found in the skin of the abdomen was perhaps out of its natural habitat. The method of disinfecting the field on the abdomen is a good one giving practically positive results in the experiment. The organisms isolated from the hair prove that the

scalp and hair to be a fertile locality for bacterial growth. While perhaps of little importance to the individual beyond that of cleanliness, to the surgeon it should be important, for while bending over an operation the wound could be inoculated from the piece of dirt or a hair falling into it from his head. Since it perhaps would be difficult to disinfect the hair, it is desirable that a surgeon should either have his beard and hair covered by some clean material or have his face smooth shaven and his head bald.

It may be said then, that, bacteria we have with us always and no part of the body surface is entirely free from them. The pores of the skin contain them and even the skin is disinfected the active sweat pores bring up organisms where they grow and multiply.

With the materials now known and used it is almost impossible to destroy all the bacteria on the surface of the body without destroying body tissue.