forming a layer still nearer the lumen. These undergoing division present a layer of *spermatids*, each one of which develops into a *spermatozoon*. In addition to the preceding cells there are others, found in all the layers, which serve the purposes of supporting and nourishing cells (Sertoli cells). The spermatozoa form the layer of cells next to the lumen. Each spermatid, in differentiating into a spermatozoon, gradually elongates; its nucleus becomes the head of the spermatozoon enveloped by a very thin film of protoplasm; the centrosome lies behind the nucleus in the middle piece or neck; the tail develops behind the neck; an axial filament runs through the neck and tail extending beyond the sheath of the latter as the end-piece. The head is from 2 to 3 μ in breadth and from 3 to 5 μ in length; the neck is 6 μ long and 1 μ ($\frac{1}{25000}$ inch) in breadth; the tail is from 40 to 60 μ long; the end-piece is 6 μ long. In profile view the head is narrow and pointed at its free end, but on surface view it appears oval in shape.

The rate of progression of a spermatozoon is about 0.05 mm. per second.

Spermatozoa possess remarkable vitality. When mounted on a slide and protected from evaporation they have exhibited motility for nine days. They have been found alive in the male genital tract four days after death. They may retain their activity in the female genital tract for several weeks.

Weak acid solutions kill them.

Structure of the Spermatic Cord. The *vas deferens* forms the axis of the cord and is about eighteen inches (46 cm.) in length. It is in the dorsal part of the cord and is recognizable from its cord-like resistance to pressure.

The *spermatic artery* is ventral to the vas, and near the testicle becomes tortuous and divides into several branches, two or three of which accompany the vas and supply the epididymis; others pierce the tunica albuginea and supply the testicle proper (*didymis*). The *deferential artery* is a long, slender vessel accompanying and supplying the vas on its dorsal side and anastomosing with the spermatic near the testis. The *cremasteric artery* courses along the cord supplying the cremasteric and other coverings. Seven or eight *spermatic veins* emerge from the dorsal surface of the testis median to the epididymis, and unite to form the *pampiniform plexus* passing mostly along the ventral plane of the vas and constituting the bulk of the cord. Farther up the cord they are reduced to two or three in number; at the internal abdominal ring they have united into one or two spermatic veins. *Lymphatic vessels* accompany the veins. Plexuses of *sympathetic nerves* accompany the arteries.

Except for a short distance above the testicle, the scrotal portion of the spermatic cord is lacking in the serous envelope; otherwise the coverings are identical with those of the testis. The inguinal part of the cord has only the following coverings, viz., the subserous connective tissue, the infundibuliform fascia, and cremasteric fascia.

At the internal abdominal ring the constituents of the spermatic cord separate and course in different directions. The vas deferens, after winding around the outer side of the deep epigastric artery, and crossing the external iliac vessels, descends at the side of the bladder into the pelvis. It arches downward and backward to its base, crossing the vestigial hypogastric artery to reach the median side of the ureter. At this point it is sacculated and enlarged, forming the *ampulla*, which extends to the base of the prostate gland (Fig. 2283, No. 3). The ampullæ are median from the vesiculæ seminales, and are between the bladder and the second part of the rectum. They constitute the lateral boundaries of the external trigone of the bladder. At the base of the prostate gland the vas deferens becomes narrowed and, uniting here with the duct from the seminal bladder, forms the *ejaculatory duct* (Fig. 2283). The vas deferens is about two feet (61 cm.) in length and about a line and a quarter (3 mm.) in diameter. The spermatic artery can be traced crossing obliquely the external iliac artery and ureter to the aorta a little below the renal artery. It rests on the psoas magnus muscle behind the peritoneum. The right one passes across the inferior vena cava.

On either side two spermatic veins generally accompany each spermatic artery for a distance and then fuse into a single vein. The right one opens obliquely into

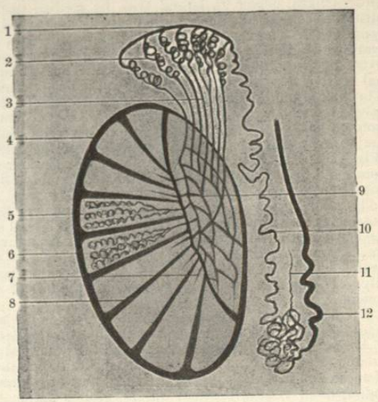

FIG. 2288.—Diagram of testicular tubules. 1, Collecting tube of the epididymis; 2, coni vasculosi; 3, vasa efferentia; 1, 2, and 3 form the globus major; 4, tunica albuginea; 5, loculus containing a lobule; 6, lobule; 7, one of the vasa recta; 8, trabecula; 9, rete testis in the mediastinum; 10, tube of the epididymis forming the body and globus minor; 11, vas aberrans; 12, vas deferens.

the inferior vena cava, the left one into the left renal vein at a right angle. The left spermatic veins pass behind the sigmoid colon with their artery. The deferential artery can be traced to the superior vesical artery at the side of the bladder. The cremasteric is a branch of the deep epigastric artery. The lymphatic vessels terminate in the lumbar glands. The sympathetic nerves are the spermatic plexus derived mostly from the renal, but partly from the aortic plexus. The plexus is re-enforced through the deferential from the pelvic plexus.

Dorsal to the spermatic cord is the internal branch of the genito-crural nerve from the lumbar plexus. It innervates the cremaster muscle. The ilio-inguinal nerve from the lumbar plexus enters the inguinal canal at varying points and appears at the external abdominal ring ventral to the cord. It gives sensibility to the scrotum.

Tunica Vaginalis (Fig. 2287). As already stated, the tunica vaginalis is the innermost of the scrotal coats of the testis, derived from the peritoneum during the descent of the testis. At birth the cavity of the tunica is directly continuous with that of the peritoneum, so that the tunica consists of inguinal, scrotal, and testicular segments. But, usually, a short time after birth, the inguinal and upper scrotal parts are reduced to a fibrocellular thread lying in the loose connective tissue around the spermatic cord; so that the tunica vaginalis is reduced to a testicular portion. There are all grades of variation between a tunica vaginalis whose cavity is freely continuous with the cavity of the abdominal peritoneum and one whose cavity is absolutely shut off from that of the abdomen, and without even the presence of a vestigial connective-tissue thread.

The *visceral layer* of the tunica is closely adherent to the testicle proper, and to the globus major and lateral part of the body of the epididymis, and is prolonged upward upon the spermatic cord for half an inch (12 mm.). It extends into the digital fossa between the epididymis and testicle. It leaves uncovered nearly all the posterointernal part of the body and the globus minor of the epi-

didymis. It is in those uncovered parts that extensive vascular communication is established between the testicle and its coverings and the cord. The *parietal layer* is continuous with the visceral layer at the point of reflection from the spermatic cord, and at the postero-inferior parts of the testicle. It is loosely connected with the infundibuliform fascia by the subserous connective tissue. The two layers are in contact normally except for a very thin film of serous fluid secreted by the endothelial cells of the tunica.

The Seminal Vesicles (Fig. 2283, No. 4). These reservoirs for the semen, to which they add their own secretion, are situated between the bladder and the rectum. They are lobulated pouches of pyramidal shape placed one on either side external to the ampullæ of the vasa deferentia, and are two inches (50 mm.) long and a half-inch (12 mm.) wide at the base. They present rectal and bladder surfaces, median and lateral borders, a base and an apex. The ventral surface is attached to the base of the bladder overlapping the ureter. The rectal surface is covered above by the recto-vesical pouch of the peritoneum, but below is separated from the rectum only by the recto-vesical fascia. The bases are widely separated, but the apices converge and narrowing into straight ducts unite, near the base of the prostate gland, with the corresponding vasa deferentia to form the ejaculatory ducts.

Each vesicle consists of a single tube coiled upon itself and giving off many blind diverticula, all bound together firmly by fibrous tissue. When uncoiled the main tube is about five inches (125 mm.) in length and of the diameter of a quill.

Each ejaculatory duct is about three-quarters of an inch (19 mm.) long, and commencing at the base of the prostate it runs downward and forward between the lateral and middle lobes to empty into the urethra, near or through the uterus masculinus. The seminal vesicles and ejaculatory ducts have three coats: an inner or mucous one, a middle or muscular one, and an outer or areolar one.

The nerves of the vesicles and ducts are derived from the pelvic plexus. The middle hemorrhoidal and the vesical arteries supply the vesicles and the extraprostatic portion of the duct. The intraprostatic portion receives its nutriment from the prostatic vessels. Veins and lymphatics accompany the arteries, emptying into the vesico-prostatic plexus.

Prostate Gland (Fig. 2283, No. 3). The prostate is a musculo-glandular body surrounding the proximal urethra and the neck of the bladder. It is in the pelvic cavity behind the lower part of the symphysis pubis. It is cephalad from the deep layer of the triangular ligament of the urethra (deep perineal fascia). It is about the shape and size of a large chestnut. It develops at puberty and atrophies after castration. It presents a base, an apex, a ventral, a dorsal, and two lateral surfaces. The base is situated immediately below the bladder; the apex rests upon the pelvic side of the triangular ligament; the dorsal surface rests on the rectum, distant about one inch and a half (37 mm.) from the anus; the ventral surface, about three-quarters of an inch (19 mm.) behind the symphysis, has some loose fat and a plexus of veins in front of it, and is connected on either side to the pubic bone by the pubo-prostatic ligaments; the lateral surfaces are in relation with the anterior portions of the levator ani muscles, the vesico-prostatic plexus of veins intervening. The prostate consists of a median and two lateral lobes. The lateral lobes are separated by a deep notch at the base and by a slight furrow on the ventral and dorsal surfaces. The middle lobe, variable in shape, is a small transverse band, placed between the two lobes at the posterior part of the gland, behind the proximal urethra. The ejaculatory ducts pass between the middle and lateral lobes. The prostate is enveloped by a thin but firm fibrous capsule continuous with the pelvic layer of the triangular ligament and the recto-vesical fascia. It consists of stroma (mostly muscular) and glandular tissue. Immediately beneath the fibrous capsule is a thick muscular layer, and around the prostatic urethra is another strong, circular, muscular layer; extending between the two are a series of decussating muscular trabeculæ, forming interstices that contain the glandular tissue. The tubular glands are arranged around the urethra in a radiating manner, and their ducts (about thirty in number) communicate by minute orifices with the prostatic sinus on either side. They are lined with columnar epithelium and secrete a milky fluid, which is added to the seminal fluid at the moment of ejaculation.

The prostate is supplied by the internal pudic, vesical, and hemorrhoidal arteries. The veins empty into the vesico-prostatic plexus surrounding the organ, and thence into the internal iliac vein. The nerves are derived from the pelvic plexus.

Cowper's Glands. These glands are two firm lobulated bodies about the size of peas and situated, one on either side of the membranous urethra, between the two layers of the triangular ligament (Fig. 2283, No. 2). They lie close above the bulb among the fibres of the compressor urethræ muscle. Each body is a compound racemose gland, and its duct, lined by columnar epithelium, pierces the perineal layer of the triangular ligament and runs forward for about an inch (25 mm.) under the mucous membrane, finally emptying into the spongy urethra. The viscid, albuminoid, transparent secretion of these glands is mixed with the seminal fluid at the moment of ejaculation.

Daniel Kerfoot Shute.

GENTIAN.—GENTIANA. "The dried rhizome and root of *Gentiana lutea* L. (fam. *Gentianaceæ*)," U. S. P. This, the yellow gentian, is one of the largest and showiest species of the genus. It is a tall, sturdy, mountain perennial, arising from a thick, fleshy, slightly branching or simple, and sometimes very long (from half a metre to one metre or more), yellowish-brown root, and is a yard or more high. It grows abundantly in the elevated and mountainous parts of Southern and Middle Europe, Asia Minor, etc. In Switzerland, Southern France, and the hilly parts of Germany, it is collected for use. Although sometimes cultivated for ornament, it does not thrive well, and rarely flowers except in its native pastures.

DESCRIPTION.—In cylindraceous, usually slightly flattened, curved or crooked pieces of indefinite length, and from 0.5 to 3.5 cm. ($\frac{1}{4}$ to nearly $1\frac{1}{2}$ in.) thick, or in longitudinal slices of the same thickness; externally yellowish-brown to dark brown, strongly and crookedly longitudinally wrinkled, and marked with lighter-colored circular root scars, the rhizome finely or heavily annulate; somewhat tough and flexible when damp, rather brittle when dry, the fracture short but uneven, the bark thick, reddish-brown, separated by a dark brown line from the yellowish or reddish-yellow inner portion; free from starch; odor strong, characteristic; taste very bitter, slightly sweetish. The roots of other species are distinguished by their smaller size and tendency to divide into numerous branches at the top. Their introduction is to be regarded as only technically an adulteration, as their properties are identical with those of the official root.

COMPOSITION.—The principal constituent of this and other gentians is the peculiar, intensely bitter, crystalline glucoside, *gentiopicrin*, first obtained in a state of purity in 1868, by Kromeyer, from fresh gentian root. It cannot, so it is said, be made to crystallize from that which has been dried. It forms clear, radiate, or clustered needles; is soluble in water and diluted alcohol, but not in ether; and by means of diluted acids it is separated into sugar and *gentiogenin*, a yellow, bitter, neutral powder. The yield is about one and two-thirds *per mille*. *Gentisic acid* is more abundant. It is in large needle-shaped crystals, tasteless, and almost insoluble in water and ether, but slightly soluble in alcohol. It is not an active substance. The root also contains a good deal of pectic matters, sugar (gentianose), etc., but no starch, and probably no tannic acid, unless the gentisic acid be considered a form of tannin.

ACTION AND USE.—Gentian is the most perfect type at our command of the class of medicines called "simple bit-

ters." In the purity of its bitter taste, the promptness of its action upon the assimilating organs, and the absence of other qualities even in considerably larger than medicinal doses, it has no equal. Concerning its physiological action in a definite way—that is, as shown by experiments in laboratories—we know but little, the more striking effects of active poisons having greater fascination for physiologists. *Gentisic acid*, when taken even to the extent of several grams, has no special action. *Gentiopicrin* has not been tested, to the writer's knowledge, in a pure state; but the older *gentianins*, etc., consisting of mixtures of the above two substances, have never shown themselves poisonous. In excessive quantities gentian and its preparations disturb the stomach and bowels, and may occasion nausea and vomiting. Sometimes it appears to be slightly laxative. Gentian is employed in medicine almost exclusively for the purpose of obtaining its stimulating effect upon the appetite, gastric secretion, and assimilating functions. Under its influence the appetite improves, the feeling of weight or discomfort felt in the stomach or bowels after eating—if due to debility of those organs—disappears, more food is taken, and probably more of what is taken is assimilated. It must be borne in mind that it probably, like other bitters, has a slight inhibitory action upon the digestive process by its presence in the mass of food. The secondary effect—viz., the improved nutrition of all the organs, and their consequently better performance of their various functions—is what is known as a tonic effect. Strength, weight, color, firmness of tissue, are all improved, and better health results. This drug is, then, indicated in debility, with poor appetite, of a more or less chronic character. Of course, acute and sudden depression, such as collapse or shock, or the weakness of fevers during the stage of high temperatures, are to be treated by stimulants, and are not suitable ones for tonics alone; but, on the other hand, during the recovery from all severe illnesses gentian may be of great value. It is often of service in dyspepsia, and, in combination with iron, in simple anæmia. As an antiperiodic it has been completely superseded by quinine; as a substitute for tobacco and opium in the treatment of those habits it has no special value.

ADMINISTRATION.—Gentian, in the form of the whole root, is sometimes chewed, and the salivary extract swallowed; the method, although troublesome, is an excellent one. The dose is not particularly important, but 2 or 3 gm. will probably do as much good as a larger quantity. There are several widely used preparations, all good. The extract (*Extractum Gentianæ*, U. S. P.), an infusion evaporated to a pillular consistence, is a nearly black, pleasant-smelling, but very bitter, soft solid, scarcely firm enough to make permanent pills. Dose, a gram or less. The fluid extract (*Extractum Gentianæ Fluidum*, U. S. P.), made with diluted alcohol, is less used than the other preparations, but represents the root well. The compound infusion (*Infusum Gentianæ Compositum*, B. P.), although not now officinal here, is considerably used; its strength is 12.5 gm. to 1,000 c.c. with orange and lemon peel. Dose, a wineglassful or two. But the most commonly used of all, and probably the most perfect bitter tonic ever made, is the compound tincture (*Tinctura Gentianæ Composita*, U. S. P.), which has the following composition: Gentian, 10 parts; bitter orange peel, 4 parts; cardamom, 1 part; percolated with diluted alcohol until 100 parts of tincture are obtained. The addition of aromatics in the last two preparations greatly enhances their value. *W. P. Bolles.*

GENTIANACEÆ.—(*The Gentian Family.*) The great size and wide distribution of this family, and the singular uniformity of its species in agreeing with the general composition and properties of the drug last discussed, render it of great importance that army surgeons and travellers generally should be able to recognize them when seen. There are no poisonous plants among them. A very few are slightly or not at all bitter and their roots or leaves are edible. Several *Coutoubeas* are used as anthelmintics. With these exceptions, all the others in use, to the number of a hundred or more, have the properties of the official *Gentian* and *Chiretta*. Among these are a large number in the genera *Gentiana*, *Swertia*, *Lisianthus*, *Pleurogyne*, *Erythræa* (the "Centaurys"), *Sabattia*, *Axacum*, etc. All show a distinct tendency toward laxative properties, and in some this tendency is marked. The family contains upward of sixty genera and nearly a thousand species, Gentiana being the largest genus, with about three hundred species. The family is represented mostly in the temperate zones and in tropical mountains with a temperate climate. They may be known by the following family characteristics: They are mostly herbs, smooth, with opposite, entire, extipulate leaves, these usually nerved or ribbed. The flowers are solitary or cymose in the axils, or at the summit, the cymes often panicled. The flowers are regular, rarely a little oblique, perfect, 4-5-merous, the corolla gamopetalous. The stamens are of the same number as the corolla lobes, alternate with them and affixed to the corolla tube or throat. The disc, if any, is inconspicuous. The ovary is superior, one-celled, or rarely two-celled by the union of the two parietal placentæ. The ovules are numerous, anatropous or amphitropous. The fruit is usually a two-valved, dehiscent capsule, rarely indehiscent, still more rarely fleshy. The embryo is small, in copious albumen, the radicle, if its direction is distinct, ascending.

Henry H. Rusby.

GEOFORM, or gaiaform, prepared by the action of formaldehyde on guaiacol, is a yellow, non-irritant powder, without odor or taste. It is soluble in alcohol, ether, hot benzol, and solutions of soda or potassa, and is insoluble in water, petroleum ether, and benzin. Heated for several days it acquires an odor of vanilla. Used by Brissonet and others, it is claimed to be non-toxic, as much as 15 gm. (ʒ ss.) a day having been administered, without inconvenience, to a dog weighing 16 kgm. (35 pounds). It is given in capsule in tuberculosis, the dose being that of guaiacol.

Tanno-geoform, its compound with tannin, is preferred for intestinal tuberculosis and night sweats, and for other sweating processes, such as hyperidrosis.

W. A. Bastedo.

GERANIUM.—CRANESBILL. *Wild Geranium.* "The dried rhizome of *Geranium maculatum* L. (fam. *Geraniaceæ*)," U. S. P. This plant is exceedingly abundant in woodlands about New York, and elsewhere in eastern and central North America, and is represented farther west by other species, with similar properties. It is a perennial slender herb, a foot or two high, with palmately lobed, roundish leaves, from two to six inches in diameter, and numerous lilac-purple flowers, something over an inch in breadth. The rhizome is of horizontal growth, 5 to 10 cm. (2 to 4 in.) long and 0.5 to 1.5 cm. (¼ to ⅝ in.) thick, more or less crooked, cylindraceous but somewhat vertically flattened, brown; roughly and shortly wrinkled and strongly, rather sharply tuberculate; fracture short, purple, the bark thin, a few short and broad yellowish wood-wedges scattered near the dark cambium; inodorous; taste strongly astringent.

Besides inert *mucilage*, *resin*, *coloring matters*, etc., geranium contains from ten to twenty-five per cent. or more of tannin, to which its medicinal value is owing. It is a mild, rather pleasant, vegetable astringent, and considerably employed in diarrhœa, chronic dysentery, etc., and as a wash, gargle, or injection, in catarrhs of the pharynx, vagina, or urethra. A fluid extract is official and represents it well for internal use. Dose, 1 to 2 c.c. (ɱ xv. ad xxx.). For washes and gargles a ten-per-cent. decoction may be made in the usual way. Cranesbill is often selected, when an astringent is needed for a child, on account of its comparatively easy administration.

Geranium will probably be dropped from the next edition of the Pharmacopœia. *Henry H. Rusby.*

GERMANDER. See *Labiatæ*.

GERMAN MEASLES. See *Roetheln*.

GERMICIDES.—Modern science having established the fact that certain infectious diseases of man and of the lower animals are due to minute micro-organisms, popularly spoken of as "germs," the term *germicides* has been introduced to designate those agents which have the power of destroying the vital activity of such organisms.

Strictly speaking, a germ is the primitive reproductive element of an animal or vegetable organism. But medical authors, in advance of exact knowledge, have long been in the habit of speaking of the "germs of disease"; and since it has been shown that in certain instances these disease germs are minute vegetable organisms, belonging to the *bacteria*, a more definite idea is attached to the word germ, and the term germicide is understood as referring to an agent which has the power to destroy organisms of this class—micrococci, bacilli, and spirilla.

It is evident that an exact knowledge of the germicidal power of various substances is desirable with a view to therapeutic possibilities, and especially with reference to the destruction of disease germs external to the bodies of infected individuals—*disinfection*. As methods have been perfected by which organisms of this class—pathogenic or non-pathogenic—may be isolated and cultivated through successive generations in sterilized media—"pure cultures"—it has become possible to determine in an exact manner the germicidal power of a given agent as regards a particular germ; and in a general way to classify chemical agents with reference to their power to destroy bacterial organisms. Already much work has been done in this direction, and it is the object of the present article to place upon record the results of the determinations which have been made up to the present date.

But before referring in detail to the experimental data, it will be desirable to give an account of the methods of research, and to call attention to the various circumstances which influence the result, and which must be taken into consideration if we attempt to compare the data obtained by different experimenters.

In the case of pathogenic organisms *two methods of determination* are available: (*a*) the inoculation of germs which have been exposed to the action of a supposed germicide into a susceptible animal; (*b*) the attempt to cultivate germs exposed in the same way in suitable culture media. In the one case failure to multiply in the body of the test animal, and in the other failure to multiply under favorable conditions in a culture medium is taken as evidence of the germicidal power of the agent tested.

Extended experiments by the method of inoculation have been made upon the anthrax bacillus (Davaine, Koch), upon the tubercle bacillus (Schill and Fischer), and upon the micrococcus of rabbit septicæmia (Davaine, Sternberg). Experiments have also been made upon the virus of glanders (Reynal, Peuch, Vallin), upon that of symptomatic anthrax (Arloing, Cornevin, and Thomas), and upon the micrococcus of fowl cholera (Salmon).

This method is very definite and satisfactory so far as the negative results are concerned—that is to say, when the agent under trial fails to exercise any germicidal power. In this case the death of the test animal, and the fact that the pathogenic organism to which this result is due is found in its blood or tissues, is sufficient evidence of the failure of the agent under trial to destroy the vitality of the germ. But the survival of the test animal cannot be taken as positive proof that the agent to the action of which the test organism was submitted has completely destroyed the vitality of this organism. This for two reasons: *first*, the inoculated animal may suffer from a modified and non-fatal attack of the infectious disease, the germ of which is used in the test; *second*, in the case of a chemical agent which has been mixed in a given amount with a pure culture of the test organism, or with blood from an infected animal containing this organism, the agent is necessarily injected into the test animal along with the germs which have been subjected to its action, and may exercise a restraining influence upon the development of these germs without destroying their vitality. This would give time for their destruction in the body of the animal by those means which have been provided by nature. The writer has elsewhere suggested that this is probably one of the functions of the white blood corpuscles, and that, when the developing power of pathogenic organisms is restrained in any way, before or after their introduction into the body of a susceptible animal, this provision of nature may suffice to prevent an attack of the disease, or at least to modify its severity.

The *second method* permits of a more accurate determination when the experiments are conducted with a due regard to the possible restraining influence of the germicide agent, which by preventing growth might lead to the mistaken inference that the vitality of the test organisms had been destroyed. This error is to be avoided by diluting the germicide agent so largely with the sterilized culture fluid into which it is introduced, along with the test organisms which have been exposed to its action, that its restraining influence is rendered *nil*. Suppose, for example, that we mix with a culture of the anthrax bacillus containing spores an equal quantity of a solution of mercuric chloride of the strength of 1 to 1,000, making the proportion of the salt in the mixture 1 to 2,000. Now, if we take one part of this mixture and add it to ten parts of sterilized *bouillon*, we shall have the mercuric chloride present in the proportion of 1 to 20,000. Experiments upon the restraining power of this salt show that anthrax spores will not grow in culture solutions containing 1 to 300,000, and that their development is retarded by solutions of 1 to 600,000. Failure to develop in this case would therefore be no proof that the growing power of the anthrax spores had been destroyed. This proof is only to be attained by adding sufficient culture fluid to dilute the mercuric chloride beyond its restraining power. The use of a comparatively large amount of the culture fluid, and of an extremely small quantity of the material containing the test organisms, permits us to exclude this source of error, for a few germs serve as well for the test as a large number. Or we may wash the test organisms in a solution which has no germicidal action but which is capable of neutralizing chemically the agent which is being tested as to its germicidal power—*e.g.*, a solution of ammonium sulphide for corrosive sublimate.

For the reason stated fluid culture media are more suitable for experiments of this nature than solids. If we bring a little of our material containing mercuric chloride in the proportion of 1 to 2,000 upon the surface of a cooked potato, or introduce it with a needle into a gelatin culture medium, the salt will not be diluted, and would exercise its restraining influence upon the germs if they had not already been destroyed by its action. On the other hand, if we add 1 part of the material to 100 parts of *bouillon* and mix thoroughly by shaking, the mercuric chloride will be diluted to 1 to 200,000; this being still within the limits of its restraining action, we may take one part of the mixture and add it to 10 parts of the sterile *bouillon*. The mercuric chloride will now be diluted to 1 to 2,000,000, a proportion quite beyond the limits of restraining action. But there will be a sufficient number of anthrax spores in the culture medium to test the question as to whether the growing power of these particular "germs" is destroyed by mercuric chloride in the proportion named.

This source of error has not been kept sufficiently in view in some of the experiments heretofore made. Again, it often happens that no development occurs for a time, but that after several days the germs which have been exposed to the action of a chemical agent commence to grow, and finally produce an abundant and vigorous progeny. In this case mistakes are likely to arise from terminating the experiment too soon. Anthrax spores, for example, develop, in a suitable culture medium, at a temperature of 80° to 100° F., within twenty-four hours, and give rise to numerous characteristic flocculi, made up of long filaments, which are readily distinguished by the naked eye. But after exposure to a germicide agent