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ORIGINAL ARTICLES

WHAT IS THE PRINCIPLE INVOLVED IN THE TREATMENT OF OPERATIVE WOUNDS— IS IT BIOPLASTIC AND CELLULAR, OR IS IT BACTERIOLOGIC?

SANITARY SCIENCE AND SURGERY FOR THE TWENTIETH
CENTURY.

Read in the Section on Surgery and Anatomy at the Forty-fifth Annual
Meeting of the American Medical Association, held at San Fran-
cisco, June 5-8, 1894.

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Have we any definite pathology, and if so, is it bioplastic and cellular or not? Dr. Hughes has told us in his paper, "it takes something more than a germ to excite disease." The President, Dr. Hibberd, said in his address: "The progress in medicine in the immediate future, must be along biologic lines, following the lead of Virchow, Beale, Ferrier, Pasteur, Kock, Sternberg and many others." I desire to accentuate this thought, and render more impressive what they have said.

Surgical pathology should be comprehended in the genesis of cells. Transition and relation to the tissue should not be forgotten. That surgical pathology is based upon a careful study of pathogenesis, is the line of progress which has been most successful in developing the rich stores of knowledge in the past, and must continue to do so in the future of conservative surgery. Have we forgotten the discussion of the histologic questions of bioplasm, cellular elements and tissue formation? Have we left behind us the doctrines biologic, views which were in some sense the foundation of the pathologic views of Rokitsansky, McCartney, Paget and Virchow? Do we believe that there is such a thing as a generation of living cells from protoplasm or bioplasm, and that degeneration, failure and death of cells and tissues may have origin in causes remote from the influence or presence of bacteria? Do we now comprehend the laws of life force, so that we say all disease springs from their presence? Is it not true that cellular elements are born, live and die as men do, new ones taking their place? If so, do not the laws of life so indicate by succession?

This began to be more fully understood when surgeons began to comprehend the processes of inflammation, and resort to means for immediate union of cut surfaces. I will not go over this beginning of the doctrine involved in such processes. Let us remember, however, the old maxim: "That art is long, experience deceptive and judgment difficult." While we do this, let us gather up the experience of the past and present, so that we may look into the future with an increasing confidence in our art, and a growing reliance upon better and improving methods. Let us test as well as gather up the facts of

results as they come to us in the methods of surgery to-day. There are many factors which enter into this question and a rigid and just analysis of all of them will the better enable us to judge, no matter how intimately and variously may be blended the known and the unknown. Every clinical history carefully recorded is experience made alive and known, and presents to every reader the *dramatis personæ* all absorbing in interest to life and person. It is the great centralization of fact in experience, viz., *the truth*.

We go back to primeval history and with historic certainty record the history and progress of our art through the ages and with contented serenity regard the wonderful discoveries of our own age. We have arrived at the top of some table land, peak or mountain top of observation, from which we look out upon the march of time and progress, observing the advance and recession of the waves of opinion. Stretching away in front we scan the outlying surface of the progress of the future, take in the mountain ranges of difficulty passed and in prospect, and wonder what mountains of difficulty and labor shall loom up before us in the future.

Like Bonaparte, whose ambition took the world for conquest and whose genius was equal to almost all emergencies (save the field of Waterloo), when his army came to the Alps in mid-winter he said to one of his generals: "Is the ascent possible?" He was answered: "Barely possible." Said he in reply: "Let the ascent begin." In this spirit we go forward in actual achievement, in almost herculean labor amid defeat, disappointment and death, yet with evident progress and *esprit du corps*; and this spirit in Europe, Germany and France speaks to America, and America back to these and other nations; while a trans-Atlantic writer having caught the spirit of the age writes this sentiment, viz.: "The medicine of the twentieth century—sanitary science and surgery." It may be surgery with Listerism, but at any rate it will be sanitary science and preventive surgery. I mean less operation and more prevention. Whatever it may be, in the advance of our science and art, it has certainly been demonstrated that cleanliness and surgery is next to godliness in life, and we accept the inevitable and call it progress. Invested with the interest which the discussions, pro and con of the past and present, have given to us, there is no subject which can occupy our minds more profitably.

In fact, from the early history of medicine to the present, no one subject has been of more value than the one we desire briefly to present in the treatment of surgical wounds. The methods have always differed, but perhaps less widely now than ever before. One of the first things to be understood is this, viz.: That there is a vast difference between a sub-cutaneous wound and an open one. In what does this difference consist is a very important question to settle. Hence that method which gives results most nearly

like those following subcutaneous injury, and this means when reduced to its simplest terms (as in algebraic formula) that method best adapted to secure primary or immediate union. Let us stop here a moment to learn what led to this view which is now accepted by the adherents of Listerism. Thanks to the revelations of the microscope, including the investigations of Pasteur, Koch and others, the present generation of medical men were taught that fermentation and decomposition are due to myriads of organisms, and these are found everywhere pervading the air and water and are rapidly multiplied under conditions of heat and moisture, especially in albuminous and nitrogenous compounds. Pasteur also showed that fluids had undergone no change when such germs were excluded and could be so excluded by filtering the air in which they were exposed through layers of loose cotton fiber. What remarkable relation this bears to wound treatment, not known or understood at the time, but applied by the revelations of the microscope becomes applied science on the basis of deduction.

In an article in the London *Lancet*, Vol. 2, page 553, by Jos. Lister, in 1867, "On the Antiseptic Principle in Surgery," Mr. Gamgee says: "On none of my visits to the Hotel Dieu, in former years, had I seen wounds look so well, and there could be no doubt that the old antiseptic practice, with a comparatively new agent had been generalized by Maisonneuve with manifest advantage, in resisting the pernicious influences of an unhealthy hospital." He says further: "The sensational circumstances under which the antiseptic system was revived in London, excited an amount of interest which detracted professional attention from great surgical principles, viz.: Rest, position, pressure and exclusion of air in healthy houses or hospitals are conducive to the healing of the majority of wounds. Pyemia, erysipelas, sloughing phagedena, and their allies are directly produced by unhealthy surroundings in hospitals. In prevention of these, antiseptic agents are of great value, but it must be borne in mind, that their use is not necessary in surgery out of unhealthy hospitals and in the absence of other unhealthy conditions." Van Swieten advised antiseptic applications in very bad compound fractures quoted in Percival Pott, (op. cit.) Vol. 1, page 451. Burgreave, "Le Genie de la Chirurgie," 1853, page 42, advises "the application of hydrochloric acid and honey as a topical preventive of purulent absorption and hospital gangrene."

Sedillot, "Infection Purulente et Pyemia," Paris, 1849, page 503, recommended the application to suppurating surfaces of aromatic wine, and decoction of bark, with or without the addition of sul. acid, sul. copper, or cor. sub." Boyer "advised the use of the chlorids to counteract the putridity of the blood." Gerdy, (Chirurgie Pract.) Paris, 1853, Vol. iv, page 146, urged that "the treatment of suppurations required amongst other means, disinfectants;" and surgical literature abounds in records to prove that the same principles have been carried out by a variety of means, among which are mentioned "benzoin or benzoic acid, clay, pitch, tar and chloralum. Hence a larger experience since has not yet fully convinced many eminent surgeons of the necessity at all times and places of the use of antiseptics.

"The fact is now, and has been clear that the disturbing influence of the carbolic acid controversy, as the disinfectant *par excellence* has been especially

marked in the treatment of wounds not made by the surgeon, viz., compound fractures; and in these carbolic oil, putty, gauze and spray have served to detract attention from the essentials, viz., air exclusion, rest, position, pressure. Fundamental principles have been lost sight of, while theories have had an ephemeral repute." While this has been true in some senses, and while Lister stands to this question in very much the same attitude as Sir J. Y. Simpson stood in relation to that of anesthetics, let us gather up the present facts and status of the question and see if it be a real progress or is it only seeming progress. We should also remember the history of the question so far as Lister's name is connected with it. It was in the old Edinburgh infirmary, where was ignored all notions of hygiene and healthy surroundings, when Lister began his experimental use of the treatment of wounds by carbolic spray, dressings of gauze, carbolic oil, etc. Since then, having risen into some notoriety he was called from the University of Edinburgh to London to teach surgery in the metropolis of Europe. Yet with his position and commanding influence he has not been able to enforce upon the professional mind the entire acceptance of his teachings. It is well it is so. Governed by traditions of experience and the dogmatism and conservatism which has been the result of our educational systems, the profession in both hemispheres has ever been slow to adopt new methods and new doctrines, and have usually applied with rigorous severity the reason and the facts. The history of surgery for the last decade in all the world shows better results, owing to something. The question is, What is that something? When in cases of fever we observe the temperature and pulse we now know that these are correlated to something, and we now know what that something is. We see the patient emaciating, wasting every day, and the problem is solved in the estimation of the excreta of the body by a quantitative analysis. So we now bring all questions to the *experimentum crucis* before accepting as proved any doctrine or theory. The opponents of antiseptic methods, of whom there are many, claim that the improvement is due to greater care, sanitary regulations, better dressing of wounds, the better comprehension of the nature of inflammation, the better comprehension of the vital forces in each case rather than to any special local dressing, including special antiseptic methods. One thing here, however, must now be conceded, viz.: That the dangers to be overcome in the treatment of wounds lies in those special reasons or conditions which cause a failure of primary union, and that these conditions are due in great measure to the changes, septic or otherwise, which take place in the wound, and these are believed now to be, if not absolutely proved to be, the presence of living germs. Here I am trenching upon the actual groundwork of the whole question, and for the sake of the presentation of the history of the question by observation drawn from the experience of men all over the world, we will admit that germs exist and through air and water and clothing and dressings come into contact with wounds.

All surgeons are acquainted by observation with the rapidity and safety of repair secured in the proper dressing of a simple fracture, and equally well with the dangers to limb and life in compound fractures. What constitutes the difference? It is not now believed to be in the greater severity of the lesion in

the latter above the former, but owing to some element introduced which produces a wide difference, and these are believed to be living germs which occasion septic inflammation and suppurative history. This engenders a poison which affects the entire organism. Pyemic conditions are induced, blood contaminated and poisoned and thus the danger is not so much from the nature of the wound as from the conditions which grow out of it. The demonstration is, I suppose, quite generally accepted that a large number of acute and specific forms of disease are dependent upon the development of various kinds of germs which may be specific to the form of disease produced, and modified by peculiar or special circumstances so as to give definite results.

Recent developments in the investigation of the special influence which seems to be exerted in the causation of disease shows a much more widely diffused agency by germs in the production of disease than had previously been supposed, and now the investigators are asserting that germs exist, only to be positively denied by others who are entitled to equal acceptance. The wide dissemination and existence of pathogenic bacteria at least gives an easy and more satisfactory explanation to rapidly spreading contagious and infectious disease, and that subtle factor which has been so much needed to explain the facts of contagion and infection is believed to be found in the doctrine of germs. "Pasteur's experiments, in which he cultivated the germs, show that certain forms of bacteria which were rapidly destructive and deadly may be so modified as to lose a large amount of virulence though reproduced in a similar manner, and this modification of power is shown to be only in a change of temperature to which they are subjected." The converse may also be true, and ordinarily bacteria which might develop serious difficulties in disease may be rendered harmless, or permitted by circumstances to be fearfully destructive of human life. Apply this thought to cholera and diphtheria, which are now classified in "Ziemssen's Encyclopædia of Practice" as germ diseases. Everybody knows the dangers accruing from the unhealthy wards of long used hospitals to the unfortunate sick or wounded, yet while this is so and while hygienic and sanitary law are constantly being thundered in our ears it is yet a fact that the sanitary condition of hospital and home, and city and town are such as to produce disease and death to many who ought not to die.

In the history of the ever-widening knowledge of our art the relationship of medicine and surgery become more and more intimate. The factors in the production of disease are proven in many cases to be due to germs, and (injuries) as wounds—whether surgical or otherwise—are shown to be more readily manageable in proportion as cleanliness and disinfectants are and have been tried. Processes are now known to be putrefactive and septic, hence the relation which the special causes of these conditions bear to wounds and other processes of disease are relations of primary importance. It has been claimed that the "exudation" material does not depend upon the presence of germs. That depends upon the fact whether inflammation is upon a free surface or entirely subcutaneous. "It is claimed that the germs are also found in subcutaneous injuries, while again others claim that septic organisms are primarily the source of all inflammatory and other troubles to which wounds are liable." To one acquainted with

the processes of cure in wounds in different individuals there can be no doubt that the processes of putrefaction differ very widely, and this is owing to various causes and conditions. In one case the vital state of the individual; 2, the immediate surroundings of the patient; 3, the cleanliness which is observed, all have much to do in the history.

Lawson Tait, one of the strongest and perhaps most uncompromising opponents of Listerism, while at the same time the most exquisite as to methods of cleanliness, yet shows most remarkable results without the aid of anything save excellent knowledge and clean hands. He draws a distinction and asserts a difference between germs upon the living and dead tissues, alleging that it is introduction of the latter—conveying germs and dead elements of tissue—which causes such serious consequences. In this, he is at least partly right and may be wholly so, as witness what occurs in the deep recesses of organs when dead elements are changed in form and become lodged in various structures as fibrin from the valves of the heart thrown into brain, lungs or liver followed by inflammation, abscess and consequences. Here there are no germs. Yet Stokes makes answer to this objection and argument thus, "That those who hold this view ignore the elementary fact that there never was a wound, and especially one in which vessels are tied or twisted, in which dead and living tissues are not at once brought into contact." "Also, if dead material is necessary for the growth of germs the abscesses which are found infested with myriads of bacteria in pyemia and in ulcerative endocarditis are difficult of explanation."

It must be true if we would comprehend the changes in the bioplastic material in health, that we must also understand the capacity of this material for living under greatly altered conditions and which varies greatly as we descend from higher to lower forms, the highest being destroyed by a slight alteration in the conditions, while lower forms of matter resist destruction and for long periods of time. The pus corpuscle and the particle of contagium, both of which are descendants of the germinal matter of the organism retain their vitality under conditions which would be fatal to the germinal matter from which they spring. Hence we can easily understand the statement of Mr. Tait, "That the bioplastic exudation from a wound in healthy tissues has a vitality of its own, often superior to the most active germs, and either fails to furnish them the necessary pabulum or walls them in from producing further damage and finally eliminates them from the body as is found in a localized abscess."

But mark the difference which is manifested in a devitalized patient in the processes of the growth and multiplication of these germs. Many blastema distinguished by their ready coagulability (dependent upon the fibrin contained) do not rise above the lowest grade of form development, and if germs of disease or any other kind find admission into such material or blastema it is easy enough to see that the development of cellular forms in harmony with the law of organization or development can not go on in order and harmony.

In the discussion of surgical questions in various parts of the world, we find developed marvelous improvements in English, German, French and American surgery during the last decade, and it becomes us carefully and patiently to investigate the causes of

such progress. If it be assumed that men are mistaken as to the merits of antiseptics in the surgical treatment of wounds throughout the world, to what then is to be attributed the great advance in success and the lessened mortality. When we take up the question of evidence we find Lister himself from 1876 to his British Association address presenting the doctrine and methods; and Mr. Savary in his British Association address on surgery at Worcester, hurling denunciations against Listerism while Tait and many others are arrayed as outspoken opponents, having tested it to their satisfaction. Savary, in this address, claimed from the statistics of St. Bartholomew's Hospital, as good or better results without the use of antiseptics. He also read another paper before the British Medical Congress of 1881, "On the Causes of Failure to Obtain Primary Union in Operative Wounds." He claims "that the remarkable improvement in the surgery of to-day is due to better sanitary arrangements, yet Mr. Savary admits two things: 1, the germ theory of putrefaction; 2, that his method is essentially antiseptic, embracing carbolyzed catgut ligatures, carbolic oil, drainage, washing the wound with a solution of permanganate of potash, or some other potent antiseptic.

Stokes, of Dublin, in his British address not only vindicates Listerism, but answers Savary by stripping his address of all its pretensions, and brings out the admissions which he makes and yet so beautifully covered up by his touches of eloquence. Keith, the ovariologist, a very competent witness, says: "For some time I have not found carbolic spray necessary, and have not used it in my twenty-seven last cases, all of which have recovered easily. With every possible care, the spray has not in my hands prevented the milder septicemia, and its effect upon the kidney was sometimes disastrous. I have seen hemorrhages from the kidney follow long operations, and two deaths in hospital patients were occasioned by carbolic acid poisoning. Though I had at one time a series of eighty recoveries under spray, I have reluctantly given it up, believing that on the whole it did more harm than good." Lister, in his discussion of the question, Is the spray really necessary? replies with candor thus: "In other words is there sufficient chance of the air of an operating theater or private room containing septic matter which can prove effective in blood serum to make it needful to regard the question of contamination from the air at all? If the answer must be given in the affirmative and the choice must lie between the spray and antiseptic irrigation during the operation at intervals, or with syringing the cavity of the wound after dressing and with every precaution, then I should give my voice decidedly in favor of the spray, as being more certain of attaining its object and involving less irritation of the wound, and also in the use of carbolic acid much less risk of carbolic poisoning." He says further: "I should not feel justified, except on perfectly established grounds, in omitting any part of the technique by which results so important to our fellow creatures have been arrived at. Finally, if further investigation should confirm the conclusion to which our recent facts seem to point and it should indeed be proved that all idea of atmospheric contamination of our wounds during operations may be thrown to the winds, then no one will say with more joy than myself: 'Fort mit dem spray.'"

Notwithstanding the earnest advocacy of careful

antiseptic surgery by such men as Esmarch, Volkmann of Germany, Spencer Wells, Thornton, McCormac, Gant, Prof. Humphrey of England, Dr. J. Marion-Sims, now dead, (all honor to his memory) with many others, the reports of the British Congress made out a verdict that antiseptic surgery had received its doom and Listerism was dead. And so the refrain has been gathered up and echoed across the continents, and the AMERICAN MEDICAL ASSOCIATION, at St. Paul, through its members proclaimed with added proof that "Listerism was dead."

Why this refusal of men in both hemispheres to accept the doctrine, if tested by sufficient experience; if not proved then wait the results of more patient and conservative testimony before reaching a final judgment. It must grow out of the impatient restraints of dogmatic teaching, or otherwise it grows out of hasty and imperfect conclusions by men who ought to be in such positions as would enable them to decide upon the value of antiseptic treatment. So late as Nov. 5, 1883, the discussion before the London Medical Society was protracted an hour beyond the usual time of adjournment to hear Prof. Lister answer the objections made to his doctrine and practice. Bryant, author of a work on surgery, made a strong case against Lister's teachings. The subject under discussion was Lister's address, and the special question was the management of recent fracture of the patella by wiring the fragments together. Besides Bryant, Adams, Bloxam, Gant, Morris, Rose, Turner and Baker concurred in the opposition to the doctrines of Lister, and Bryant contended that strict Listerism was not necessary in order to be perfectly in accord with the grand principles of antiseptic surgery, which in the minds of the opposition means strict cleanliness in everything pertaining to the dressing of wounds, as well as the most perfect hygienic conditions about the patient. "Bryant thought that any operation upon the patella was unjustifiable, because the results of the old-fashioned treatment were in his experience quite satisfactory."

So we find Listerism is not accepted in Lister's own home in London, yet we should expect that the fiercest fight of ideas will come from men who live in his own city, verifying the old aphorism, "That a prophet is not without honor, save in his own country." Coming directly to the facts of the subject, Do they sustain the extraordinary claims of antiseptic surgery, it would seem that the verdict of the two great medical associations, British and American, ought to be able to settle this question, yet we are of the opinion that the verdict will be made by a more universal congress than either; the matured judgment and opinion resting upon it of the surgical thought and experience of the world. When this verdict of judgment will be rendered is still in the future. It may be long after Lister has departed, when his works shall be freely weighed and estimated. In such a vast problem it is very difficult to obtain reliable data, as "facts seem to have a special aversion to registration." Statistics alone can in time show the bearings of this question; in the question of suturing the broken patella we have the results in forty-nine cases which show 16.3 per cent. of suppuration of knee joint, 6.12 per cent. of deaths, 4 per cent. of necrosis of fragments, 4 per cent. of amputation of thigh—and which results completely negative the dogmatic assertion of Lister in his address that "antiseptic treatment converts

serious evil into complete safety." In favor of the operation it must be said, "that a large majority recovered with bony union and excellent use of the joint." But let it also be remembered that in eight cases there was suppuration of the joint and other grave difficulties—as exhaustion, death, pyemia, amputation; and in others which recovered of the eight there were stiff joints and necrosis of fragments.

Ovariectomy is not now regarded as a very dangerous operation. Its dangers have been greatly diminished by the precautions which have been thrown around it by antiseptic methods, and yet it is believed by many, among whom are Keith and Tait, that the antiseptic method is not so valuable here, while Lister himself regards his method in this field as least successful. Spencer Wells in this field has the most remarkable experience and which sweeps over a wider range, giving it as his unqualified opinion that both in safety and rapidity of recovery it is the most efficient and protective of agencies. Keith has abandoned the use of the spray, but is not inclined to the use of the method so much as formerly.

We have not time to review the broad field of surgical endeavor and must close without attempting a statistical review of the various kinds of operations and wounds resulting, as the statistical evidence is not yet full enough, nor complete enough with all the conflicting evidence in the question to determine the full value. In the cases of compound fractures, and other open wounds affecting large joints, are found a class of cases which furnish the best proof of the value of antiseptics. Prof. Volkman reports seventy-five successive cases of compound fracture without a death, and does not hesitate to claim that without infection there is no suppuration, and that to obtain primary union, by which is meant immediate union, two factors are necessary; complete disinfection and absolute opposition, so that the parts have the chance of growing together. "While admitting," Volkman continues, "that a depraved constitution and a devitalized condition would render the patient less able to resist the influences of germs or poisons, he asserts as a demonstrated clinical fact "that such patients have a revivifying bioplastic power sufficient to afford immediate and complete repair if treated antiseptically." We doubt this, as stated, because it is as fully demonstrated that there is an organic dyscrasia, by which is meant some "unknown aberration of nutrition" in certain cases; which can not be remedied by any processes yet made known to us. This dyscrasic state of the blood is a factor in disease now recognized by the leading teachers of medicine in the world, among whom are Vogel, Libert, Rokitansky and many others. Hence, while using disinfectants the general question of nutrition must be comprehended. We have said these organisms are found in this relation *post puerperium*; hence the question arises, What relation exists between these and septicemia?

The fact of existence under the circumstances indicates some present relation. No condition exists in such cases by which these could so readily find admission to the interior of the body as after a lying-in or confinement. These changes are believed to be septic changes in the uterus, and the modes of introduction. There are three modes of infection: 1, absorption by the lymphatics; 2, extension of septic changes along the mucous membrane of the Fallopian tubes into the abdominal cavity, as seen in

the ovaritis by the gonococcus, which is a typical case in gonorrheal inflammation. This affects the lymphatic system, as seen in the enlarged inguinal glands, but its most permanent effects in the female are due to extension of inflammation along the mucous surface to the peritoneal cavity; 3, *direct passage* of septic matter into the circulation, as by the two first methods the septic matter reaches the circulation and causes or may cause metastatic abscesses in various organs. The uterus, under the conditions after delivery, presents most favorable conditions for such development. The veins close by thrombosis, and the septic material containing the microorganisms are rapidly thrown into the circulation. The latter method is the most likely mode of infection in this case.

If we would understand the present state of our knowledge as to the relation of microorganisms to puerperal septicemia, we must study the literature of the subject. Here we shall no doubt find a solution of that much *questio vexata* of puerperal fever, and here we may find a firm basis of pathologic facts, instead of vague theories and changing views or notions, upon which to ground a successful treatment.

HISTORICAL RÉSUMÉ.

The literature of this subject is fully brought up to about 1880 or 1885 by Dolores and monographs by Lusk, a more recent one by Lomer, and a beautiful work by Woodward. Hare gives an exhaustive description of pyemia and allied conditions. Attention was first directed to the subject in 1869 by Coze, Feltz and Mayerhofer of microorganisms as a cause of puerperal fever. They have been found since by others. They have been traced from the diphtheritic lining of the endometrium through the lymphatics, into the peritoneal cavity, and also by the lymphatics through the diaphragm. Pasteur, the celebrated investigator of organisms, recently applied to the study of hydrophobia, has given his investigations in seven cases of puerperal fever, various forms of germs being found in the progress of this disease. The exact relation of germs to the development of this disease and septic poisoning generally has not yet been satisfactorily tested, but there have been established some very important facts, viz: That we have the same pathologic changes in puerperal as we have in surgical fever, and that these hold the same relation to the germ theory. In most cases we have to do with blood poisoning from wounds identical in pathology with the poisoning of the blood from an amputation wound.

The conclusion from all that is known is that the condition of the interior of the uterus occupies the same position as to the septic poisoning as the stump of an amputation wound. The lochia gives valuable information as to the state of the uterine surface, but we should remember that we may have septic absorption going on when there is no factor of the lochia. We must distinguish between putrefying matter and septic matter, as all putrefaction within the uterus after delivery will cause septic poisoning, but all septic poisoning does not imply that putrefaction must have occurred as to the fluids. This difference grows out of the difference in the microbes which mark each process.

Finally, the germ theory receives confirmation from the fact that those substances which are shown to be

the most effective in the destruction of germs have proved most useful in the treatment of septicemia. It is a fact well observed and established beyond question that washing out the uterus with antiseptics in cases of puerperal fever is followed by most remarkable results in the reduction of temperature and pulse. Carbolic acid was first the favorite remedy, but solutions of bichlorid of mercury seem to possess so many advantages that it is among the most popular remedies because it is more destructive to germs. Toxic effect has been charged to both remedies, but bad results only occur in improper use or strength. So I would use solutions which destroy germs and produce antiseptic results, and thus save cases from the development of those much to be dreaded forms of disease, pyemia, septicemia and puerperal fever. This answers the questions at the head of this paper, and shows us that prevention in surgery as in medicine takes the form of the trans-Atlantic writer: "The medicine of the twentieth century, viz: Sanitary science and surgery."

THE TREATMENT OF OPEN FRACTURES.

Read by title in the Section on Surgery and Anatomy at the Forty-fifth Annual Meeting of the American Medical Association, held at San Francisco, June 5-8, 1894.

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If aseptic surgery had been practiced only in the treatment of open (compound) fractures, it would have accomplished much for humanity. It is safe to say that there are not one half as many amputations performed since the commencement of the present treatment as formerly. Lives have been saved that otherwise would have been sacrificed, and useful limbs are now seen where a few years ago, a wooden substitute was worn as a perpetual reminder of the shortcomings of the surgical art. The aseptic treatment of an open fracture requires first the thorough cleansing of the limb and the wound. The limb should be shaved and washed clean. Irrigation with boiled water is the best means of securing cleanliness of the wound. If there should be venous oozing, it should be stanching with hot water, or irrigated with a bichlorid of mercury solution 1 to 4,000. The styptic effect of this solution is at once seen in the bleaching and drying effect produced. Any spurting vessel should be tied with carefully sterilized catgut. The next step is to secure accurate coaptation of the fragments, sharp splinters (*spiculæ*) should be removed, but broad fragments, even when considerably comminuted, should be readjusted. The elevator and the heavy bone forceps will be frequently needed to bring the fragments into position. It is well known that the principal causes of non-union, outside of constitutional causes, are: 1, want of apposition; 2, interposition of muscles; 3, excessive motion. Every care should be taken therefore to avoid these causes of non-union.

Direct fixation of the fragments is one of the most important indications. This may be accomplished by periosteal suture or bony suture. I have many times secured good union in bones of the foot, for example, by the periosteal suturing of the fragments. Chromicized catgut or whale tendon should be used, and a sufficient number of stitches taken to bring the fragments together. In case the obliquity is such

the fragments can not be brought together by periosteal suturing, then the osseous suture may be made; after trying many expedients, and experimenting with many kinds of suture, I have reverted to silver wire as being that best adapted to the work. These sutures in some soft bones may be passed obliquely through with a stout needle, but generally a small drill hole must be made to enable the passing of the wire. The wires must after twisting, be left long and project from the wound so as to facilitate easy removal.

I have had no experience with the use of bone dowel plug placed in the medullary canal to secure fixation. It has seemed to me so liable to be septic, and there must be so many practical difficulties in the way of final removal, as to make it a dangerous appliance.

In five cases I have used the bone ring introduced to the notice of the profession by Professor Senn. In every case there was suppuration, and I have abandoned it, until such time as we shall be enabled to sterilize the ring. It is yet so far from perfection in that regard, as to make it almost certain that the wound will become infected. The principle may be yet found useful by the invention of some different material. The bone ring (or thimble) has one advantage, that is the great amount of exudate (forming callus) which is excited by the presence of the ring. So pronounced is this effect, that in cases of ununited fracture where there is no attempt at the formation of callus, the ring may be used to advantage notwithstanding its general lack of sterilization.

The condition of the soft parts must next be looked to. Indeed it is a matter which is scarcely secondary to the proper treatment of the fractured bone. Wounded tendons, torn muscular structures and lacerated nerves should be sutured according to the rules laid down for the respective tissue involved. Stout chromicized catgut will be found useful for tendons, and fine flexible catgut for nerves. In case the distal and proximal ends of a nerve or tendon can not be brought together, they may be sewed to the nearest adjoining nerve or tendon. All this takes time, but it will be well spent. When the wound is cleaned the bones are brought together, and the soft structures thus attended to, then irrigation is again practiced and the external wound closed by sutures of silk-worm gut. Extension is usually not necessary if the fragments have been brought into perfect apposition, nor is there much difficulty in retaining them. External support should be secured by a plaster-of-paris bandage, and when necessary a fenester cut opposite the wound.

In complying with the wishes of our distinguished chairman, to keep within the ten minute line, it will be seen that I have chosen rather to support the existing practice, than to compile the literature of the subject, and if more attention shall be directed to methods of suture of the soft parts, in addition to bone fixation, the paper will have served its purpose.

FISSURE OF THE ANUS.

Read in the Section on Surgery and Anatomy, at the Forty-fifth Annual Meeting of the American Medical Association, held at San Francisco, June 5-8, 1894.

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The lesion known as fissure of the anus is an elongated oval ulcer from one-fourth of an inch to an inch in extent and of variable depth. By many authors it is designated irritable ulcer or painful