Bollinger of Munich, Boudet of Paris, Heitler of Vienna, Flint of New York, and Fowler of London, with numerous other observers who can confirm their observations.⁹ This is a fact which should have great publicity, to both awaken and quicken hope and dispel the pall which falls over one in whom an early but kindly diagnosis has been made for self and friends; for with no malady is the error more prevalent than with pulmonary tuberculosis, that it is incurable, whereas the contrary prevails.

Phthisio-therapeusis is to-day held in a thralldom of ignorance and superstition, by the physician and the layman, that is deplorable in the present light of collateral knowledge.

The study of the physiology and chemistry of respiration is overlooked in the eager search for a specific for the unwelcome plague that blights so many homes. The avidity with which every phantom is reached after that is projected into the darkness, attests this truth; and we need not look backward very far to the time when Weigert's hot-air inspiration was a fad; or when Bergeron's bombardment with sulphuretted hydrogen was urged in homes and hospitals, but is now a discarded and disowned outcast by parent and employer; respirators, inhalers and exhalers have burdened the patent office and glutted a hungry market; costly cabinets have been built and leased to regulate intrathoracic pressure, when it has been a long known physiologic truth that the proportion of oxygen in the blood can not be increased by pressure, nor is it diminished by reduction of the pressure until it approaches a vacuum.¹⁰ When inanition has proceeded so far that muscular dynamism is no longer co-ordinated to functionate normal respiration, involuntary or voluntary, then mechanical resuscitation in broken-down or diseased pulmonary tissue would be indeed futile if not absolutely injurious.

Public-school text-books do not teach, and medical teachers and students do not study, the anatomic aids or physiologic processes of normal respiration enough. Solid and liquid foods and culinary arts are studied until cooking is regarded as an index of civilization. The therapeutic market is congested with digestive aids, until physicians and laymen are confused as to what to choose, whose or which chemical aid they shall invoke to conduct or complete a low, plain, simple, organic process, when innocence and abstinence alone should indicate the remedy; while, the first food we grasp for quality or quantity at our advent here, and the last we sigh for before we go hence, the "breath of life," and its uses, we utterly ignore.

Every physician accustomed to auscultation too often recognizes, especially in women, the inadequate function of respiration; another class, in whose members the same defect is observed, comprises the indifferent workman and tobacco habitués; still another is that easy-going, quasi-sporting element, including the gourmand, whose whole thought is to that zone below the diaphragm, whose choked liver and kidneys soon mark their habit and chrome their skin.

I once had an opportunity to auscultate a healthy chief of the Cheyennes, on the plains of Montana, and while breathing freedom's air from childhood, his lungs hung like a flabby appendix in his massive thorax, and I knew that the traditional "wind" of the Indian was a myth, and the "white plague" would soon wipe out his race.

A comparison of the post-mortem evidences of repair of tuberculosis of the various tissues of the human body shows that the lung far exceeds any other tissue in the body—not excepting the peritoneum—in its ability to overcome the effects of tubercular inoculation.

This, it must be admitted, is largely due to the systemic circuit of the obscure bronchial artery and its nutritional activity; while it also urges that a due anatomic and physiologic recognition of this artery, as belonging to the systemic and nutritional system as distinct from the purely functional one of the pneumonic system, will tend to introduce study for strengthening healthy, and repairing diseased, lung tissue through the proper channels, instead of clinging to the popular though erroneous methods of projecting or aspirating medicaments into and upon the mucous surface, that we know must stop at their first impact; the vibrillary motion of the cilia lining the bronchi, which is constantly toward the point of entrance, must prevent them, either by gravity or current, from ever reaching their intended, traumatic or diseased destination, whether these medicaments be sprays, nebulae or gases.

Nutrition and repair of impaired pulmonary tissue must be carried on through channels, identical with other similar processes, in other structures; and this, it is recognized, must be done through the metabolic functions of the systemic blood-current, by the selective affinity or specific action of tissue,¹² each fiber for its part, and in this the bronchial artery is the only source of nutrition for pulmonary histologic elements, and the pulmonary veins and pulmonary artery have no function for this.¹³

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SOME POINTS IN TREATMENT OF SEVERE CRUSH INJURIES OF THE EXTREMITIES*.

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In almost twenty years of observation, but more especially as attending surgeon to a large general hospital, which experience has been supplemented by a considerable experience in railroad injuries also, the writer has been particularly impressed with the urgent need of a better knowledge and comprehension, by the general profession, the general surgeon, and even the railroad surgeon, of the character of severe crush injuries of the extremities, the prerequisite to the proper insight to treatment. It has been a too frequent experience to witness the loss of limbs, and even loss of lives, from surgical treatment so much worse than useless as to be pernicious, and which displayed an amount of ignorance on the part of the practitioner which might be considered criminal, were the efforts not clothed with good intentions. It has been a too frequent observation that surgeons seemed to lack a proper knowledge of the surgical principles involved, and also that even railroad surgeons fall short of the best results.

The general practitioner fails from a lack of the application of surgical principles, contained in all our text-

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books on surgery, though perhaps not sufficiently well formulated, nor definite enough in their application to special cases. The general surgeon may fall short of expectations because lacking a large observation of these special cases, so necessary to the highest success in any special field, more especially this one. The railroad surgeon will probably not be lacking in surgical principles, and his experience may be well rounded, but he may fail of the very best results, by not possessing the inspiration which will carry his practice beyond the ordinary or routine.

The writer claims nothing new, nor original, in any ideas which he may present here, but he desires to emphasize what appears to be a general need for a more universal application of the principles of drainage in a class of cases in which it is most urgently needed, if the greatest good is to be secured.

So large a proportion of railroad injuries come within the scope of this article, and the results of treatment are so important to all concerned, that it would seem desirable to promote discussion, and disseminate our conclusions that improvement in treatment may be secured to the unfortunate.

Severe crush injuries are necessarily contused, lacerated wounds of a class that involves extensive destruction of cellular tissue, with portions perhaps destroyed in mass, conditions favorable to sepsis, with an enormous amount of dead tissue and wound fluids producing tension, with its attendant inflammation—a natural hotbed for bacterial development. Such conditions necessarily require a full comprehension of the principles of drainage, which I have sometimes thought was becoming one of the lost arts in surgical practice, being actually ignored because of the insane desire to carry out what is erroneously conceived to be the principles of antiseptic surgery; in reality, drainage is one of its most useful handmaids.

It has been the observation of every railroad surgeon, that it is quite impossible to form a correct estimate of the amount of destruction suffered by the tissues, in a subcutaneous railroad crush, or the amount of damage done to tissues near to, or even remote from, a severe injury of this class. The writer therefore deprecates the too common tendency to so-called conservatism in these cases, by the watching and waiting course, which surely brings the necessity for surgical intervention for the production of drainage, necessitated by the onset of sepsis, which surgical intervention, if performed at the outset, might have averted the sepsis, with all of its possible attendant consequences; among which may be mentioned the various infections, septic lymphangitis, thrombophlebitis, gangrene, spreading gangrene, and the general dangers to the patient of septicemia and pyemia. The dangers from pent-up wound fluids and necrotic tissue are greater than the possible harm from incisions intelligently made, or from any danger from infection through such wounds, the compensating advantages being infinitely greater than their possible disadvantages. Indeed, these incisions often reveal the necessity for drainage, which might otherwise be overlooked. Insufficient surgical intervention may subsequently call for interference out of all proportion to the most radical initial requirements.

Contused tissues are always subjected to a severe tax on their vitality, by an impaired venous return. The force of the arterial current is usually less at fault. It is this condition of the circulation which accounts for the great tendency to the extravasation of blood and serum, so favorable to the production of swelling and

tension, which still further adds to the embarrassment of the venules. It has probably been the observation of every surgeon, that multiple incisions in skin flaps of doubtful vitality will often preserve their integrity. This is accomplished by the application of this principle, in relieving the burden of the return circulation. An extended application of this resource, in the treatment of considerable masses of contused tissues, as found in a crushed member, is often equally magical in its benefits. I therefore maintain that its intelligent application will accomplish results impossible of attainment by any other method, in the treatment of tissues not actually deprived of vitality. It will therefore be seen that the application of this principle will necessitate an apparently radical treatment, of seeming unnecessary severity, at the outset, which will in reality relieve the engorged tissues of their burden of dead cells and waste products, and safeguard the living cells from bacterial attack; also furnish avenues of escape for necrotic masses of tissue, relieve pain, and save the patient the dangers attendant on swelling, sepsis, and inflammation, and its necessary consequences. My plea, therefore, is for drainage sufficient to relieve the wound spaces, otherwise liable to extravasation fluids, and the living tissue cells from undue embarrassment.

To these principles of treatment must be added the application of the best surgical methods for carrying off and maintaining the wound products aseptic. This may be accomplished by an abundant hygroscopic dressing, though in the more severe cases the moist antiseptic dressing is more efficient. But in the worst of cases, continuous submersion, or continuous, through-and-through irrigation with an efficient antiseptic is required to accomplish what is demanded in desperate cases, which are usually already very septic.

A considerable experience has found formalin so valuable in clearing up septic conditions of the more malignant type, that it has led the writer to believe that we have in this agent a most powerful antiseptic, destined to a place of first rank, in the treatment of all septic conditions. While the writer believes that the devitalized masses of tissue should be removed at once, or at a comparatively early period, yet he believes that in the use of formalin we have an agent which will maintain dead tissue free from germinal invasion, and innocuous to the living tissues, and is itself incapable of exerting a very devitalizing influence on the living cells if used in proper strength. This enables the surgeon to conserve tissues otherwise destined to destruction, and at the same time not be an element of danger.

The principles herein set forth have been largely followed in the cases reported by the writer, under the titles "Conservative Foot Amputations," before the Omaha Medical Society, in November 1897; "Amputations," before the Western Surgical and Gynecological Association, in December of the same year; and "Skin Grafting in the Absence of Amputation Flaps," before the Nebraska State Medical Society, at its meeting in 1895.

This paper has left untouched many points in connection with this subject. A treatise was not intended. The emphasis of a few essentials, so regarded, is all that has been attempted. And though the writer's recommendations should not be indorsed by some, this much will be granted, that the following of these lines of treatment would certainly be an improvement on the results obtained from the practice of those who are possessed of a penchant for sewing up severe, contused, lacerated, even mangled members, and the failure to establish adequate

early drainage—the too common practice of the average practitioner and a fault from which the general surgeon and some railroad surgeons are not altogether free.

DISCUSSION.

DR. W. RUMML, Cedar Rapids, Iowa—I desire to say a word or two in reference to the use of formalin, in connection with the paper of Dr. Lord. I have been using moist formalin dressings for some time, and so far they have proved eminently satisfactory. I use $\frac{1}{2}$ per cent. solution of formalin for saturating sterilized gauze, and the gauze is applied moist. In this way drainage is favored, and the oozing from the wound cared for by the dressing and does not macerate the wound area.

DR. EDUARD BOECKMANN, St. Paul, Minn.—I was very favorably impressed with the remarks of Dr. Lord in reference to drainage. I have tried to do ideal surgery without resorting to drainage, but the older I grow the more I come back to treatment of wounds with it. As regards formalin, I have had no surgical experience with it. I have always considered it a good antiseptic, just as efficient as any other material for this purpose, but I do think its germicidal properties have been greatly overestimated. Formalin has been recently recommended for the purpose of preparing the skin, and in the opinion of prominent surgeons it is the best antiseptic we have for disinfection of the site of operation, and I should not wonder if formalin, used as a dressing, will prove as efficient as many other agents we now use. I rather believe it is a good remedy for dressing wounds, and will certainly try it when opportunity presents itself.

DR. J. P. LORD, closing the discussion—If I can see a case of railroad injury in its incipency, or very soon after its occurrence, I do not believe the use of formalin either for the purpose of submersion or irrigation of the part is necessary. Thorough drainage with sterilized water may prove sufficient; but in cases where the wound is already foul, we have a valuable agent in formalin. Bichlorid of mercury, which was formerly so much used, I do not usually apply as a moist dressing, because there is considerable albuminous secretion which soon forms the albuminate of mercury, and this is inert as an antiseptic. In such cases I am a friend of carbolic acid, unless there is too great danger from absorption. My experience with formalin dates about two years, during which time I have used it extensively in clearing up unclean wounds of various kinds, and particularly necrotic ones, and where a limited space is to be covered I use it as strong as 2 per cent. of the forty volume solution, but that would make it much less than its percentage would indicate. I have found that even one-half of 1 per cent. was sufficient to devitalize granulations during that period of progress of the wound when granulations were so desirable. It exerts a much more powerful influence on the tissues than our first experiences led us to believe. I have seen granulations destroyed repeatedly by the application of 1 or 2 per cent., used for two or three hours. I have seen granulations destroyed by washing the part with a 2 or 4 per cent. solution. In a day or two thereafter I have seen a tanned necrotic layer appear on the surface, which must slough off before further progress can be made. The remedy should be used with considerable caution and in very weak solutions; $\frac{1}{8}$ of 1 per cent. is the usual strength now used by me.

I recently had a case in which there was a most intense form of infection following a railroad injury, it being necessary for me to extend the palmar incision up through the palmar fascia, to open the sheath of the flexors clear to the elbow. The septic condition extended almost to the axilla, and it was evident that the patient would succumb if relief was not afforded, consequently the whole palmar surface of the man's hand, wrist and arm was laid open; the diseased tendons were cut away, and the wounds were packed with formalin as a dressing, shortly after which there was a very material reduction in the temperature of the patient, and it was really remarkable to see what formalin did in this particular case. Formalin was used as often as it was deemed necessary. Here is one case of infection where formalin acted in a marvelous manner.

THE DIPLOMATIC representative of Bulgaria at Paris during the Exposition year is a physician, Dr. Kolotovitch.

TREATMENT OF GUNSHOT WOUNDS OF THE ABDOMEN: SOME NEW STATISTICS.*

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The surgery of gunshot wounds of the abdomen, which has been for some years pretty well settled to the satisfaction of the profession, received something of a shock by the report of the surgeons who served in the late war with Spain (see *THE JOURNAL* for July 9, 1898, and the published report of the last meeting of this body.) yet the inferences, and indeed the conclusions, affect surgical judgment to a considerable degree. It was because the settled data of private surgery were so much at variance with these reports that I deemed it justifiable to inquire a little further into the subject. The result of the investigation by Klemm shows, in an analysis of 152 cases, that even those in whom penetrating wounds in the abdomen were established, who did not die of immediate effects, eventually nearly succumbed to exhaustion from sepsis and later suppuration. The meaning of this is that, practically speaking, all penetrating gunshot wounds of the abdomen, untreated by surgical repair of the lesion, die either of hemorrhage, peritonitis or sepsis. It is not to be denied that a small bullet, in certain situations, pursuing an unexpectedly favorable course, may occasionally fail to produce a fatal injury, but it will be seen from the statistics I have reported, as well as those of Klemm, that such favorable results did present in only about 6 per cent. of over 400 cases. The complete analysis of the subject, made by Dr. W. E. Parker, settled, by the comparison of the reports of a large number of reliable operators, the following points:

The mortality after operations done in the first seven hours after injury is 52 per cent., as against 64 per cent. for operations at all periods. But a study of the table of Parker shows such variations in the mortality succeeding complicated and uncomplicated wounds of the various viscera all of fatal character without operation, as to indicate that, in uncomplicated wounds in some situations, the early operator will often save 75 to 80 per cent. of what would otherwise be fatal cases. His table also shows that of sixteen operations done, in which no intraperitoneal injury was found, three died, one from an overlooked perforation, and two from peritonitis due to infected blood clot—the fatal complication on which Klemm lays so much stress. Thus we see that no death was referable to the operation even as a contributing cause. It also appears, that in considerably over a hundred cases—the exact number is hard to get at in the table, as in the classification it was necessary to duplicate often—there was no reported recovery from operation done twenty-four hours after injury.

There is still one other important deduction from this invaluable paper, supplemented as it is by many other sources of testimony: almost all operators agree that there is no reliable symptom of perforation or mortal lesion in the operable hours after injury. It will be interesting to review these facts in connection with the study of the reports I shall present a little later. Notwithstanding these, and others of an equally convincing nature, it is still published in current medical literature, and still finds a place in valuable text-books on surgery, that a considerable per cent. of untreated gunshot wounds of the abdomen will recover; and that treatment by operation may be deferred until symptoms indicate perforation.

Confronted by this state of things I decided to send

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