COMPARATIVE RESULTS OF OPERATIONS IN
BELLEVUE HOSPITAL, NEW YORK.

By STEPHEN SMITH, M.D., New York.

FORMERLY everything was subordinated to celerity in operation; now mere haste is mentioned but to be condemned; recovery without suppuration is the end sought; perfect cleanliness and thorough antiseptics of operation, assistants, patient, instruments, and dressings is required, by the use of (1) soap and water to external parts, (2) carbolic solution for all instruments, (3) bichloride solution for all surfaces and tissues, and (4) iodoform for external dressings—all this in contrast with the disregard for cleanliness formerly in vogue. Sponges are elaborately purified; the ligature is aseptic and not expected to "come away," drainage tubes used but as a temporary expedient, if at all, no suppuration being expected, and the help of a wound being brought by deep and superficial sutures into complete apposition; in contrast with former careless methods of applying dressings the present method is careful in the extreme, consisting of a dusting with iodoform, layers of disinfected material with iodoform between the layers, the whole being retained by bandages of disinfected materials carefully preserved in a disinfected atmosphere. The results obtained are as much in contrast as are the procedures: Compound fractures, which under the old fracture-box or gypsum-splint treatment always suppurated, resulting often in loss of life or limb, are almost uniformly cured without any drawback by (1) removing from the wound every particle of matter liable to injure the tissues and induce suppuration; (2) placing in fixed apposition all the tissues composing the wound; (3) cleansing and disinfecting the wound, and protecting it from becoming soiled during recovery; (4) protecting the wound by immovable dressings from any movement of the parts entering into it while the process of repair is going on. Amputations, the wounds from which rarely, if ever, recovered, except after long continued suppuration, the larger ones being terribly fatal, are now among the most successful operations. Excision of the larger joints, which was formerly a most doubtful and dangerous operation, involving suppuration and confinement for months, as a rule now do not suppurate, union taking place by rapid and healthy granulation.

The danger of secondary hemorrhage after the ligation of large arteries has passed away now that the artery need no longer be divided by the ligature, but is strengthened by a non-irritating and preferably absorbable ligature; no suppuration occurring, the artery enlarges externally at the seat of the operation, while the coagulum organizes internally, and closes its caliber. Cold abscesses, not connected with bone, were preferably allowed to open themselves, or, if touched at all, opened by a "valvular" incision and the pus allowed to flow out at several sittings; now they are cured promptly, without suppuration, by opening freely and, with the curette, scraping out all old granulations and diseased tissues, cleansing the cavity with bichloride solutions, and pressing the walls together with disinfected dressings. Abscesses connected with bone are freely opened and thoroughly cleansed with bichloride solutions, which secures rapid recovery. Fractures of the patella, formerly the surgeon's *bête noire*, are invariably cured by wiring the fragments, with antiseptic precautions. The same change is observable in the gynecological surgery of the institution. All these improvements are secured in spite of the fact that the hospital is an old shell, containing in its walls and its environments all the conditions that in modern times are regarded as unhealthful and unsanitary, and can be attributed only to the superiority of the methods now employed over those formerly in vogue.—*Annals of Surgery*.

REMOVAL OF SEWAGE.

At a recent meeting of the American Society of Civil Engineers, New York, a paper by Mr. W. Howard White, M. Am. Soc. C. E., on European Sewage and Garbage Removal, was read. This paper states that:

For sewage removal in Europe, five methods are at present in use: 1st. Dry removal. 2d. Water carriage, simple. 3d. Water carriage, with purifying (precipitation) works. 4th. Water carriage, with filtration or irrigation. 5th. Dry removal, and working up into salable products. The first method is in most general use still. The second method, more or less introduced into all large cities, was brought about by covering in of water-courses and introduction of pressure water supply. Denser population and sluggish rivers led to use of third method, leading, first, to intercepting sewers, and then to purification. The latter is about to be adopted in London (recommended by Royal Commission, 1884, who declare condition of Thames below London unbearable). Experiments show that a month's sewage of the city is generally to be found floating between Barking and the river mouth.

Precipitation is successfully practiced in Leeds and other cities, giving a clear effluent and a disposable, but non-salable, manure. It is claimed that the effluent again decomposes, if carried far in sluggish streams.

Cost per capita in Leeds for purification, 22 cents per annum.

Cost per capita in Leeds for dry removal, 24 cents per annum.

If the whole population in sewered district which now uses sewers for slops used them also for excreta, cost per capita is estimated at 16 cents. This includes cost of purifying slops. Dry removal figure (24 cents) includes removal of ashes and garbage.

No allowance is made for cost and maintenance of sewers, because these are needed any way for slops and storm water.

Taking interest and cost of maintenance on these into account, total cost per capita per annum for storm water, sewage, and slops, 45 cents.

Knostrop works at Leeds consist of 12 settling basins, 60 feet by 100 feet, with pumps to raise sewage, and appliances for cutting out any basin for cleaning. Precipitation effected by mixing milk of lime with sewage. Sewage passes from tank to tank, over division walls, and under intercepting walls, to prevent surface current. First five tanks cleaned every five days; sixth and seventh, about once a week. Others very rarely. Deposit in tanks, when cleaned, averages: In No. 1, 21 inches deep; No. 2, 18 inches; No. 3, 10 inches; No. 4, 6 inches; No. 5, 5

inches; No. 6, 4 inches. In the last five, never over 1 inch. In the works now building at Frankfort-on-the-Main, sewage flows through 3 tanks used simultaneously, giving slower velocity, which if attained may be advantageous; but no precautions are taken against surface flow. Out of four tanks provided, one will always be in process of cleaning. By placing works some distance below the city, Mr. Lindley has been able to operate ordinarily without pumping, except for cleaning basins. He has thought it necessary to cover the basins with vaults, to prevent interference with cleaning by ice. This does not seem necessary.

Precipitant to be used at Frankfort is aluminoferric. Acid in this is set free by reaction with alkalis in the sewage, and alumina remaining precipitates the solids by its affinity for organic substances. As alkalis in sewage are not sufficient to neutralize all the acid, milk of lime is added to render the whole action of alumina available. Where there is much acid in sewage, this process is not practicable, because as much lime is needed as without the process.

Advantages claimed: 1st. Precipitation of impurities in solution as well as in suspension. 2d. Effluent not so liable to after-putrefaction. 3d. Does not make so much sludge. 4th. Less danger of escape of free lime.

Irrigation is used, with great advantage, for smaller towns.

Best conditions: Town lying high enough for natural drainage to irrigation farm, and latter high enough to be drained by 5 foot subsoil drains; depth of drains determined by climate partly. Town of Harrogate, Yorkshire, is a good example of irrigation. Has the above conditions, with slopes steep enough to give rapid circulation and rapid drainage. Population, 10,000. Sewage farm, 230 acres. Depth of drains, 4 feet (found too shallow). Effluent fairly good, except occasionally, in dry weather, when ground cracks. In our drier climate, with land equally sloping ($\frac{1}{4}$ to $\frac{1}{2}$), drains should not be less than 5 to 7 feet; with flatter land, shallower drains can be used, but more land is needed.

Sewage arrives at sewage farm finely comminuted. Leaves no paper on surface of farm. When sewer was broken near town, ground in neighborhood was covered with paper. Authorities believe paper is ground up and dissolved in flowing half mile further to sewage farm. Appears more probable that it collects at points in the system, and that the flood that broke the sewer (storm water being partly carried in it) dislodged it.

Harrogate's experience shows the difficulty of using irrigation for cities over 100,000. Sewage farm becomes too large, requiring 1 acre for 50 to 100 people with favorable Harrogate conditions, while for large cities the farms would have to be scattered about. Harrogate's farm, worked by city and fairly remunerative, could be combined with poor farm in our towns of similar size.

Favorable features in our climate: The ameliorating effect on ground of warmth of sewage in winter, and greater capacity for sewage in our dry summers.

Modification of irrigation is filtration proposed by Frankland in 1870. Land is chosen of a level character, with sandy or chalky soil, and thoroughly sub-drained. Divided into 4 plats, upon which sewage stands successively 6 hours on each. Accepted minimum area, 1 acre per 1,000 people. Town of Kendal, Westmoreland, has purified sewage this way for ten years, with 850 people per acre, and effluent still good. Only coarse crops can be raised, and it seems only a question of limited time until soil becomes choked with sludge. Recommended for large places only, with preliminary precipitation, as by Royal Commission on Metropolitan Sewage Discharge (London) in 1884. Precipitation works proposed at Barking, discharging over filtration area and again into Thames. Cost of preparation of land for this plan, \$350 per acre. Land itself for London would cost \$1,000 per acre. Cost per capita for filtration would be 5 cents. Precipitation, as in Leeds, 16 cents. Total, 21 cents per annum. Sewer for London can be extended to deep water of British Channel at annual cost per capita for construction, maintenance, and pumping out, 27 cents for population of 6,000,000. Cost of above outlet would cover one with slight addition for the population of the Thames Valley of 10,000,000. Cost per head would then be 20 cents against, at least, 21 cents, as before, for filtration requiring 10,000 acres for filter-beds alone.

Recent experiments show advantage to fish culture of very dilute sewage, forming an argument for discharge of sewage into large bodies of water.

5th. Method practiced on largest scale, at Manchester, England, where urine and feces partially deodorized with the house ashes are removed in pails to manufacturing depot, where they are converted into manure (along with the market garbage and dead animals) and into a variety of materials like soap, oil, candles, and mortar, all of which are used by the corporation, except mortar and manure, which find ready sale. Cost uncertain, somewhere between 24 cents and 37 cents per capita per annum. This includes also destruction of garbage and dead animals, which expense I have not been able to separate.

Liernur separate pneumatic system costs, at its best, 22 cents per head per annum, exclusive of interest on plant and dust and garbage collection. More expensive than any other well-arranged system.

Summing up: Dry carriage never economical or healthful. Combined wet carriage expedient for closely built towns or quarters of same where slopes are not excessive. This supposes branches large enough to carry sewage and relieve streets of ordinary rains, and provision of overflows for interceptors to carry off all water not needed to dilute sewage to innocuous points.

Separate system, applicable to steep streets or permanently rural neighborhoods, where storm water can be carried in gutters and natural water-courses.

As to disposal of sewage: The sea or a body of fresh water as large as our great lakes is a natural receptacle. To be discharged in small towns on such waters directly into the same, with provision for future interception and carriage away from town or out into the sea or lake to a safe distance. Where direct discharge is inadmissible, irrigation first resort, followed by precipitation and filtration.

Berlin, instance of large city using irrigation. Had in 1884 13,322 acres of sewage farms, with 1,200,000

population, and will probably be driven eventually to preliminary precipitation. Impossible to lay down hard and fast rules. Dantzig irrigates, though near the Baltic, because it was able to do so to great advantage. Providence declined to irrigate, because it could purify sufficiently by precipitation to discharge into Narragansett Bay.

New York will probably have to carry its sewage to sea eventually, and Chicago several miles out into the lake, at a point a good way from its water-taking inlet.

Cities on the Mississippi will, at a distant day, have to resort to preliminary purification before discharging into the river.

European sewerage depends too much on hand cleaning. Sewers should clean themselves by normal flow, aided by drains or automatic flushing with ground or other water.

No particles should enter a sewer which the minimum velocity in the same cannot carry. The main difficulty, where sewers are at all well proportioned, is with street washings. These should be kept out by proportioning catch-basins so as to drop all heavy matters into the bottom, by making the velocity through the basin at all times less than the least velocity ever occurring in the sewer, and intercepting floating matters by a diaphragm across the basin. The diaphragm to be removable, and bottom of basin to be formed by a pot, which could be lifted and dumped by a derrick on a wagon for the purpose of carrying off the washings. Grease should always be shut out of the sewers by grease traps at the houses.

That fouling matters of a heavy or floating nature (not suspended) can be kept out of sewers is shown by the Dantzig experience with siphons under the river, which have required no cleaning for fourteen years, owing to the adoption of measures similar to the above. Overflows for storm water had better be long, narrow openings at the level in the sewer to which it is filled when enough diluted to overflow, allowing swimming matters to pass over as soon as this level is exceeded. Should be on the side of the sewer and not on its axis, so that the current would scour them, and not tend to choke them.*

Sewers large enough to enter can be made at small expense large enough to carry all underground pipes and electric wires, and give room for making repairs and connections without tearing up the streets.

Ventilation in European systems wrong in using house soil-pipes for ventilating sewers. American systems would be better if only one untrapped opening to open air were used, viz., a pipe carried up along kitchen chimney. This would cause constant tendency of air in house drainage toward this pipe in case any leak occurred in the pipes—the air drawing into the pipes from house, and up kitchen-chimney pipe—and would avoid freezing of water-pipes by circulation of cold air in soil pipes alongside them. Only chance of sewer gas getting into house with such arrangement is stoppage of the kitchen-chimney air-pipe at a time when house traps were empty, or by kitchen chimney being cold under same circumstances, which almost never occurs, if ever, in an occupied house.

Disposal of dead animals, garbage, dust, ashes, and other matters not suitable for the sewers, handled in the United States very crudely.

Destructors applied at various points in England and Holland accomplish this by fire at small cost. The two at Leeds consist of brickwork cells, with sloping hearth continued down into grates. All refuse is fed in at top, and works down gradually to the grate, where fire once started is kept up by the refuse. The hot gases pass off by side openings through the flues of a steam boiler, which runs a mortar-mill. Latter grinds up clinker from the furnaces with lime, and makes first-class mortar. Old iron is sold as it comes out of ash-pit. All infected mattresses and clothing, and dead animals and condemned meat, are put into the destructor and consumed, without any fuel being used except the dry garbage and cinder left in the ashes from the houses.

Burnantoft destructor burnt up in year ending August 31, 1884, 1,538 tons rubbish, 23,207 tons ash-pit rubbish, 45 beds, 96 mattresses, 58 pigs, 9 cows, 9 sheep, 4 quarters bad meat, the product of 100,000 people, at a net cost of £1,087 12s. 10d.

If the system were applied to New York, with a population of 1,500,000, where removal of same matter to deep water now costs \$175,000 to \$200,000 annually, the Leeds cost per 1,000 of \$50 per annum would make \$75,000 for New York. Destructors are placed in Leeds on less valuable property; rate of interest is about three-quarters of that here; cost of labor, two-thirds. Safe to estimate expense at double that of Leeds, or \$150,000 for New York, leaving still a margin, after absolutely destroying many things now only partially got rid of. It is alleged that the poorer population wash their ashes into sewers and burn the large cinder. Hence, not enough fuel collected from ash-bins to operate destructors. If so, the practice should be stopped by inspection, and by obliging tenement owners to provide ash-spouts over which ashes could be sifted.

ON A CHEMICAL DIFFERENCE BETWEEN
LIVING AND DEAD PROTOPLASM.†

By OSCAR LOEW, Ph.D.

It has been long since a question why the manifold chemical changes going on in a living cell of a plant or an animal suddenly cease with the death of the cell. None of the hypotheses offered proved to be satisfactory. The living cell is undoubtedly full of a wonderful chemical energy, and the most complicated syntheses are performed with ease. Think of a bacterium, that lives and multiplies in acetate of ammonia solution, and forms its albumen, fat, and cellulose from this compound of so simple a composition! Think of the continued production of protoplasm that goes hand in hand with the perpetual destruction by respiration, and certainly a most energetic chemical activity becomes evident.

* Leeds borough engineer has devised overflow by letting off the surplus water under a float gate, which rises at the point of proper dilution of sewage, and at same time shuts gate in main sewer, so that all the flow is eventually discharged through overflow as long as the flood continues. Makes it possible to proportion interceptors for sewage alone. Some doubt how satisfactorily such a float-gate would work without very careful inspection.

† Lecture before the Physiological Section of the British Association meeting in Aberdeen, September, 1885.