

IS THE PURGATION OF PATIENTS BEFORE OPERATION JUSTIFIABLE?

A CLINICAL AND EXPERIMENTAL STUDY

By WALTER C. ALVAREZ, M.D., SAN FRANCISCO

From the George Williams Hooper Foundation for Medical Research, University of California Medical School

AS is well known, it is a common custom to prepare patients for surgical operations by purging them. The writer has been so impressed at various times by the harmfulness of this procedure that he has come to question whether it is really necessary, and if so, why. A review of the literature and the questioning of surgical friends alike have failed to elicit satisfying answers to these queries. When asked why he purges before operations, the average surgeon says that he wants the stomach and bowel empty when he cuts into them, as in a gastro-enterostomy. That fails to explain why he prepares in the same way for a tonsillectomy, for the removal of a breast, or the amputation of a finger. Besides, as is well known, he does not depend upon finding the viscera empty, but uses clamps in all gastro-intestinal cases. With these clamps, it does not make much difference whether there are two or six ounces of fluid in a stretch of bowel. As Mayo has pointed out, the difficulties and dangers of using such clamps in the colon are *increased* by purgation. It can easily be seen that the chances of soiling the peritoneum are greater with liquid than with solid fæces (1).

Moreover, the surgeon must know that the small intestine is empty in from 7 to 9 hours after a meal. In seven years' experience in radiographing the digestive tract, I have seen perhaps a dozen cases in which the ileum contained food after fifteen hours (2). Since operations are usually performed in the morning, from 12 to 18 hours after dinner, there is certainly no need for giving a purgative to clear the small intestine. The only place left in which fæces can stagnate is the colon; and, in most cases, that also would empty itself spontaneously on the morning of operation, if it were left alone. Failing this, it could easily be cleared by enemas. I have

convinced myself by radiographing patients after they have taken an enema to clear out barium-containing fæces, that the colon can be emptied very thoroughly in this way. It would seem, then, that the preparatory purgation can be dispensed with, if its only object is the emptying of the bowel; enemas would serve just as well.

The anæsthetic. When "cornered" by these arguments, some surgeons have taken refuge behind the skirts of the anæsthetist — they have said that her work requires the preparation. Apparently they do feel this way, because when a man applies a cast in his office, he doesn't think of preparing the patient, but if the same thing is done in a hospital, after the administration of a little ether, purgation is deemed essential. I immediately questioned some of the leading anæsthetists of this city, who promptly disclaimed any desire for pre-operative purgation of their patients. They had not observed any difference between the behavior of emergency and "prepared" patients so long as their stomachs were empty.

Fear of auto-intoxication. Other men have expressed a fear that the presence of fæces in the bowel might lead to the absorption of toxins. Here, again, I would suggest that there is no need for alarming ourselves over something that has never troubled the majority of people. Why should we be worrying about "auto-intoxication" in a patient whose bowels have always moved regularly, or who feels none the worse for four or five days' constipation? The surgeon may answer that he fits the preparation to the case: that such patients are not purged; but from conversation with head nurses and a perusal of the instruction sheets tacked up in some busy hospitals, I fear that such discrimination is not often employed. If there is to be any absorption of toxins, it seems more reasonable to suppose that it would be from churned

together" (15). Burton also speaks of giving "clysters and suppositories to draw the humor from the brain and heart to the more ignoble parts" (16). Later writers took these theories and added to them. The following quotations are offered as samples of medical thought a hundred or more years ago. In the first English *Practice of Physic* printed in 1776-1798, Cullen (17) says: "Purging has the effect of diminishing the activity of the sanguiferous system, and of obviating its inflammatory state!" Another physician writing in 1819 says: "The stimulus of purgative action at once energizes the languid and torpid state of vital power . . . and induces actions . . . that directly conduce to invigorate and amend a weakened or diseased state of the parts" (18).

One can easily see why men holding such views about purgatives should give them to healthy persons who were about to undergo some ordeal, and who wished to be in the best possible condition. We find that they purged those starting on a journey, those who were to be bled, and those who were to receive emetics (19). Burton tells us that they even prepared the patient who was to be purged by giving him so-called lenitives and preparatives (20). Carneades, the Academic, purged himself before entering upon a debate with Zeno, the Stoic (21). His idea was that if hellebore, the drug used, sometimes cured madmen, it should sharpen the wits of the sane. Naturally, when inoculation came into vogue, the candidates were purged. It is interesting that as early as 1776, Cullen questioned the value of "*these pretended preparatory courses of medicine*" (italics mine). He remarks that "other mischievous effects have sometimes appeared" (22). Jenner apparently had too good sense to advise purgation before vaccination, although others did "prepare" their patients (23). A young American medical student (24) who was in London in 1801 writes: "When inoculated, Woodville gave these people five grains of rhubarb and ordered five grains more to be taken in about a week, *principally to quiet the parents!*" Men who were to be tortured for the extortion of confessions were prepared by the giving of purgatives (25). Although it was believed that if

the accused were innocent, God would stand by him and make his suffering so bearable that he would not have to perjure himself, it was thought best to have him in as good physical condition as possible.

It was not so easy to find references to purgation before operation in the earlier works on surgery: perhaps because such books deal almost entirely with wounds and fractures. One of the few non-emergency operations done by the ancients was the removal of the cancerous breast. Let us see why these patients were purged. Galen held that the cancer would not have grown if the function of the part had not been depressed by an evil humor such as black bile. This had to be purged away before surgery could have any prospect of success. These theories were still current in the time of Ambrose Paré (26).

Some may say: what is the use of dragging in all this ancient history; those ideas cannot influence us today. Let us not be too sure of that; let us see when they were given up, and why. I, personally, had never realized how enduring these old theories were until I found the learned Doctor Adams, in 1847, seriously discussing the pros and cons of some ancient quarrel between Galen and his successors (28). The fact is, that humoral pathology could only be downed by exact knowledge gained at the autopsy table and in the laboratory. It is hard to realize how recently this change has come. Even Rokitsansky's great work on pathology, written in 1842-1846, was marred by "his attempt to revamp the ancient drivel about solidism and humoralism" (29). It was left to Virchow (1846) with his *Cellular Pathology* to break away entirely from the old ideas. Pasteur applied his research to medicine and laid the foundation of bacteriology in the years from 1877 to 1885; and Lister devised antiseptic surgery in 1867. Ideas which have been held for two thousand years cannot be uprooted entirely in seventy years, and no student of history will doubt that they are influencing us today. Practices always tend to persist long after the motive is forgotten. If this practice of purging before operations is really based upon humoral pathology, it should be given up (not mitigated), unless it

can find new support in physiologic and pharmacologic research.

Preparation is being given up. If purgation is really a good preparation for an ordeal, if it "energizes the vital powers," why isn't it employed by athletes? Why doesn't the college trainer give the track team a dose of salts all around the night before the big meet? Any one who has been in athletics knows that that is about the last thing on earth he would do. As Oliver Wendell Holmes (27) says: "If it were known that a prize-fighter were to have a drastic purgative administered two or three days before a contest, . . . no one will question that it would affect the betting on his side unfavorably." He goes on to say that if this be true for a powerful man in perfect health, how much more true it must be of the sick man battling for his life.

The fact that the most serious and complicated operations are done successfully in research laboratories on animals which are not purged, shows that there is nothing in the operation itself that necessitates such preparation. Still more convincing is the argument that nothing but good results have followed the abandonment of routine purgation in human cases (30). I have talked with a number of busy surgeons who, for years, have not been purging their operative cases, and who are all enthusiastic about their improved results. They all comment on the greatly decreased amount of vomiting, flatulence, dynamic ileus and gas pains. Very significant also is the fact that others who still "prepare" have made the process much milder. Where it used to be ten grains of calomel and ten grains of jalap, or two compound cathartic pills, it is now a laxative or an ounce of castor oil given 48 hours before operation, so that, as the surgeons admit, the patient will have time to recover a little. When a review of the literature showed this marked tendency of surgeons all over the country to diminish the severity of purgation or to discontinue it altogether, I began to question the need for writing this article. Further investigation showed, however, that there are some reactionaries who are pleading for a return to drastic preparation, and claiming that it is a sure cure for all postoperative

troubles (31). Another thing that has induced me to publish at this time is the fact that a number of surgeons, particularly those in the country, have told me they did not dare say anything about having given up preparatory purgation for fear that, in case of accident or of a damage suit, they might be condemned for their unwarranted innovations. It is interesting that almost all of these men state that they gave up the routine purge at the suggestion of their nurses, who kept asking why it is that emergency appendicitis cases have such quiet postoperative courses as compared with the well-prepared "interval" ones. During the last four years I have questioned a large number of experienced nurses, asking them which they would prefer looking after, an emergency or a prepared abdominal case, and the answer has always come back unhesitatingly: "The emergency case, of course." They have all agreed that the stormiest after-courses and the worst gas pains are met with in the elaborately prepared cases.

EXPERIMENTAL WORK

It was with the hope of throwing a little experimental light on this subject that Mr. Fletcher B. Taylor and I undertook some work on purged animals. It seemed reasonable to suppose that if purgatives have either tonic or depressant effects on the gut, these effects should be demonstrable in the excised segments, which will contract rhythmically in warm oxygenated Ringer's solution. I was interested to see if any change could be shown in the gradients of rhythmicity, irritability, or latent period. I have suggested elsewhere that the downward progress of food through the tract depends largely upon a gradient of muscle forces, of irritability, and rhythmicity, i.e., the upper part of the bowel not only contracts more powerfully under stimulus, but it reacts more promptly and beats more rapidly than do the parts lower down (32). The intestinal contents move from the more active, irritable regions above, toward the more sluggish, less irritable regions below. It can easily be seen that the regular, uninterrupted progression of material in the bowel must depend on the smoothness of this

gradient. An upset in the gradient might occur if the purgative should happen to depress or fatigue the upper end of the intestine more than the lower (33). Even a general uniform exhaustion of the muscle might be a serious complication after a laparotomy, when the surgeon often wants the bowel to react promptly to carminatives or purgatives. So often the deplorable state of a patient is due to the fact that when the postoperative purge fails to act, stronger and stronger ones are given and are retained.

A full report of the experiments will be published elsewhere.¹ Rabbits were used because excised segments from their intestines contract so regularly in Ringer's solution that deviations from normal are easily detected. In spite of conditions which are ideal for fermentation, the intestine of the normal rabbit contains practically no gas; the walls are tonic and grasp their contents firmly. Five animals received castor oil; four, magnesium sulphate; five cascara; three, calomel; and three, compound tincture of jalap. For the most part, mildly laxative doses were used. If the animals had been purged to the extent that patients are purged, the changes in the bowel would probably have been more striking. The drug was given about noon, and the animals were killed the next morning at nine o'clock. Segments for study were taken from five different places in the bowel. Six well purged animals were apathetic and looked sick. The bowels of these animals were injected, full of fluid and gas; sometimes atonic and flabby, often irritable here and there, and inclined to contract down into hard white cords. When the excised segments were put into the warm Ringer's solution, their contractions were weak and irregular, and they soon became fatigued. They were less sensitive to some drugs applied locally; in some cases, the doses had to be increased one hundred times to produce any effect. The importance of this observation will be evident to the man who knows how difficult it is to make the bowel respond to drugs after purgation (34).

Of seven moderately purged animals, six showed some intestinal gas or other abnormal-

ity. In three, the segments contracted poorly. Some of the animals which received doses too small to produce purgation were also full of gas and showed signs of intestinal paresis.

From these observations, magnesium sulphate would seem to be the most objectionable purgative for the surgeon. On account of its well known action in preventing the absorption of water by the bowel, the intestines in the animals purged by this drug were distended and full of fluid. Calomel and cascara did not seem to poison or fatigue the segments as did castor oil, magnesium sulphate and jalap. With calomel, the segments beat well with a large amplitude and slow regular rhythm.

The gradient of rhythm in the excised segments was irregular only in the animals that received castor oil. Probably this gradient would have been found to be more upset if it had been studied in the intact intestine with the animals opened under salt solution. Records obtained in this way from diarrhœic animals showed very irregular gradients of rhythm (35). More striking deviations from normal were found when the latent periods of the segments were studied. Normally, there is a certain gradation from short latent periods in the duodenum and jejunum to longer ones in the terminal ileum. In the purged animals, some segments were more irritable than normal, and had shorter latent periods; while others would hardly respond at all to the strongest current. Colic and gas pains might be due to the distention of such paralytic regions by gas forced into them and held there by more irritable and powerful loops above and below. In the normal intestine, the gas, if not immediately absorbed, would promptly move aborally because the oral end of the loop would be stronger, quicker and more irritable than the aboral end.

The injection of the intestinal wall and the engorgement of the mesenteric vessels noted in many of the rabbits deserves mention. It has been observed after purgation in man. Such a disturbance in circulation might upset the delicate balance between the gases in the intestine and those in the blood.

¹Alvarez and Taylor. *J. Pharm. & Exp. Ther.*, 1917, x, 365.

SUGGESTIONS

That this paper may not close with purely destructive criticism, the following suggestions are offered. They have all been put into practice by surgical friends whose reports so far have been encouraging. Naturally, it is not to be expected that the measures recommended will entirely eliminate gas pains. Much will always depend upon the nature of the operation, the constitution of the patient, the amount of ether used, the amount of peritoneal drying, and the gentleness or roughness of the operator.

Unless there is serious gastro-intestinal stasis from obstructing lesions at the pylorus or in the bowel, the patient should eat his usual dinner. As Crile says: "It is a serious mistake to starve a patient too long (or to purge too severely) before an operation" (36).

Unless the operation is set for an early hour in the morning, he may sleep in his own bed the night before. If he is very nervous and apprehensive, he had better take a full dose of adalin or other soporific to insure rest.

If the operation be set after 10 a. m. and if there be no lesion causing gastric stasis, a breakfast may be given consisting of the patient's usual coffee with a roll or some toast or a plate of smooth mush. No physiologist would ever expect to have an animal's bowel tonic and in good condition for class demonstration or for research experiments unless food had been given that morning (37). Mr. Taylor and I studied excised segments from four rabbits starved for four or five days, and found the contractions diminished in amplitude and strength. Ordinarily, a light breakfast should leave the stomach in two or three hours. In patients with duodenal ulcer, gall-stones or achlorhydria, most of it would probably be gone in an hour. Experience alone will show whether or not his suggestion is practical and the results worthy of the extra trouble. It is very possible that fear and apprehension will so lengthen the emptying time in many people that food will remain to interfere with the action of the anæsthetic.

If the patient's bowels move normally every day, and particularly if they move on the morning of the operation, as they prob-

ably will do if the breakfast is allowed, no enema should be given. Enemas need be given only to those who are definitely constipated, or who are to undergo operation on the lower colon or on the pelvic organs.

Gas-oxygen should be used when possible, as it upsets the digestive tract very much less than ether does.

Solid food should be given as soon after operation as possible, on account of its tonic effect on the tract, and its tendency to restore the downward currents (38). The thing to be avoided is the cellulose in fruits, salads and green vegetables. Give the patient all the water he wants. Unless it is very cold it will not stimulate peristalsis very much. It certainly cannot do harm in the lower bowel as it is absorbed so rapidly in the duodenum and upper jejunum. Given freely, it often stops vomiting; it washes the stomach; it lessens the dangers of retching, as vomiting is made so much easier; and a considerable amount of fluid will generally be retained (39). This enables the surgeon to dispense with the Murphy drip, which undoubtedly tends to keep up reverse peristalsis, and in many cases is largely responsible for the nausea and gas pains. Weeks' article on the subject is timely (40). He might have added that this apparatus is being used more and more as a fetich, after short operations in which there has been no loss of fluids and no shock.

Avoid postoperative purgation; certainly do not give it as a routine on the fourth day. So often the patient's after-course is uneventful until this dose is given. There is no harm done if his bowels do not move, especially if he hasn't been getting much food or if he were purged beforehand (41). McPherson (42) has shown very conclusively on 644 consecutive cases that the routine purgation after confinement is not only useless but harmful. The women were placed alternately in Wards A and B. Those in A had no catharsis; those in B were subjected to the usual routine. Of the 322 in Ward B, 28 had some fever (over 100.4°) during the puerperium; of the 322 not purged, only 3 had fever, and one of these had a mammary abscess. A considerable number of the women

who were left alone had normal bowel movements; others were given an enema every third day. None of them had any of the symptoms supposed to go with auto-intoxication. There was less danger from infection by the spreading of loose movements over the vulva. The mothers were saved much discomfort and the nurses endless labor. McPherson rightly concludes that the lowgrade fever of the puerperium can be due to the catharsis: to the stirring up of the colonic bacteria and not to any constipation.

Many surgeons will probably answer that some of their postoperative patients would have died with intestinal paralysis if they had not employed heroic measures and had not forced a bowel movement through. Rixford tells me that after years of consultations on such cases, he is satisfied that the purges do not *cure* the desperate cases; when they succeed, they simply show that peritonitis, if present, was not extensive enough to preclude recovery. If the intoxication is severe enough, the bowels will never move again and the patient will die no matter what is done (43). If the purge is simply a test to distinguish between the curable and the incurable, we ought often to restrain our curiosity, as the testing sometimes takes away the little chance the patient did have for recovery.

The prompt use of salines after operations is due largely to the teachings of Lawson Tait. He maintained that we must begin active purgation the minute distention appears. No time must be lost, because later, the purge may not work. He admitted that he had no right to say that he cured peritonitis, "but this I do know, that the moment we see distention we purge, and if we succeed in purging, the patient recovers; if not, she dies. Therefore, I am content to say that at least *we prevent peritonitis* (italics mine), and it is for that purpose that my routine treatment is directed" (44). Whatever we may think of the practice itself, it would seem that an antivivisectionist, a man who in 1892 could sneer at the "fashionable germ theory of disease" and who thought peritonitis was due to "a disturbance of the ebb and flow of the

serous stream in the peritoneum" is hardly the one to be directing the thought of physicians in A. D. 1917.

SUMMARY

To sum up briefly, the reasons for avoiding purgatives before operations are:

1. Some of the purgatives owe their effects to the fact that they are irritant poisons that must be removed quickly from the body. Others act by interfering with intestinal absorption and by upsetting the balance of salts. In either case they bring about pathological conditions. The body is weakened and not strengthened.

2. We know now that the dehydration of the body and the upset in salt balance are bad, particularly before an operation in which there may be hæmorrhage and vomiting.

3. With magnesium sulphate, there may be an increased amount of fluid in the bowel to disturb those who want it empty. In operations on the colon, liquid contents are harder to control mechanically than are solid masses.

4. There is an increased growth of bacteria. There is some evidence that there is an increased absorption of toxins, and a greater permeability of the mucous membrane to bacteria. Undigested food may be carried down into the colon to supply increased pabulum for the bacteria.

5. By weakening some parts of the bowel and making others more irritable, the even flow of material from stomach to anus is rendered impossible.

6. Whether from disturbances in motility, in absorption, in the circulation, or in the bacterial conditions, there certainly is a tendency to flatulence and distention.

7. When the bowels must move frequently during the night, the loss of sleep is considerable. The purgation is particularly trying if the patient is wearing a large cast, has a broken leg, or other painful lesion which makes each resort to the bedpan an ordeal.

8. If the patient should happen to have some intestinal obstruction, a gangrenous appendix, a badly diseased Meckel's diverticulum, or adhesions forming around some pus, purgation may directly cause death.

9. Purgation makes the bowel react so poorly to drugs that there may be grave difficulties in meeting postoperative emergencies.

10. Emptying the bowel by starvation and purging makes the resumption of colonic activity much more difficult. The colon must be filled and distended to a certain extent before it will empty.

11. The fact that children and nervous women will sometimes begin vomiting during the night, *before* the operation, shows that the purge must be responsible for some of the postoperative nausea and vomiting. The ether adds the finishing touches to what was begun the night before.

It is suggested that food be given as late as possible before operation; that even enemas be avoided if not absolutely necessary; that water and solid food be given by mouth as soon after operation as possible; and that purgatives be avoided after operation as well as before.

1. MAYO, W. J. J. Am. M. Ass., 1916, lxxvii, 1282.
2. CASE, J. T. Med. Clinics, Chicago, 1916, 1, 842; Carman and Miller. Arch. Int. Med., 1915, xvi, 406.
3. HERSHELL. Chronic Colitis. London: 1914, p. 222.
4. KLIMENKO. Ztschr. f. Hyg. u. Infektionskrankh., 1904, xlviii, 110.
5. BOOKER. Johns Hopkins Hosp. Rep., 1897, vi, 253.
6. FICKER. Arch. f. Hygiene, 1905, liii, 179; 1905, liv, 354. For excellent discussion and literature, see Beitzke: *Ergebn. d. allg. Pathol.*, 1910, xiv, 312.
7. KADER. Deutsch. Ztschr. f. Chir., 1891, xxxiii, 57-272; Boycott, J. Physiol., 1905, xxxii, 353; Murphy and Brooks, Arch. Int. Med., 1915, xv, 410; Zuntz and Tacke, *Deutsch. med. Wchnschr.*, 1884, x; Strauss, J. Am. M. Ass., 1916, lxxvi, 267.
8. LEICHTENSTERN. Verhandl. d. Cong. f. inn. Med., 1889, viii, 42.
9. ZUNTZ. *Deutsch. med. Wchnschr.*, 1884, x, 717; Boycott and Damant, J. Physiol., 1907-1908, xxxvi, 282; Boycott, J. Physiol., 1905, xxxii, 343; Kan Kato, *Internat. Beitr. z. Path. u. Ther. d. Ernahrungstoerungen*, 1910, i, 315; Fries, Am. J. Physiol., 1906, xvi, 468.
10. SCHIERBECK. *Skand. Arch. f. Physiol.*, 1893-1894, v, 1-12; Woodyatt and Graham, *Tr. Clin. Path. Soc., Chicago*, 1912, viii, 354.
11. GEORGE and LEONARD. *Roentgenologic Diagnosis of Surgical Lesions, etc.*, Boston: 1915, p. 140.
12. CRAIG. Am. J. Obst., N. Y., 1904, xlix, 453.
13. BURTON. *Anatomy of Melancholy*. London: 1849, p. 452.
14. GALEN. Quoted by Adams, *Paulus Aegineta*. London: 1847, iii, 485.
15. HALY ABBAS. Quoted by Adams, loc. cit., 487.
16. BURTON. Loc. cit., p. 450.
17. CULLEN. *First Lines of the Practice of Physic*. 4th ed. Edinburgh: 1784, ii, 157.
18. KINGLAKE. *Lond. M. & Phys. J.*, 1819, xlii, 443; Alonzo Clark, *Pepper's System of Medicine*, 1885, ii, 1146; Rapin, *Rev. méd. d. l. Suisse Rom.*, 1915, xxxv, 390.
19. PAULUS AEGINETA. Vol. iii, 507.
20. BURTON. Loc. cit. See also *Paulus Aegineta*, iii, 479.
21. Idem. Loc. cit., 442.
22. CULLEN. Loc. cit., 155.
23. *Med. Repository*, 1802, v, 483, 256.
24. SPALDING, MATTHIAS. Unpublished manuscript.
25. GARRISON. *History of Medicine*. Philadelphia: 1914, p. 235.
26. PARK, ROSWELL. *Med. Libr. & Hist. J.*, 1903, i, 241.
27. HOLMES. *Currents and Counter Currents in Medicine*. Boston: 1861, p. 37.
28. ADAMS. *Paulus Aegineta*, London: 1847, iii, 485.
29. GARRISON: *History of Medicine*, Philadelphia: 1914.
30. WALKER. Am. J. Obst., N. Y., 1906, liv, 722; *Blood-good, Progr. Med.*, Phila., 1913, December, 216; Quain, J. Am. M. Ass., 1912, lix, 29.
31. MCNEILE. *Calif. St. J. Med.*, 1916, xiv, 189.
32. ALVAREZ. J. Am. M. Ass., 1915, lxxv, 388.
33. Idem. Am. J. Physiol., 1917, xlii, 446.
34. BOAS. *Therap. Monatsh.*, Berl., 1904, xviii, 621.
35. ALVAREZ. Am. J. Physiol., 1915, xxxvii, 277.
36. CRILE. J. Am. M. Ass., 1914, lxxii, 129; Moore, *Surg., Gynec. & Obst.*, 1908, vi, 282.
37. CANNON. Am. J. Physiol., 1907, xx, 301; Ducceschi, *Arch. di Fisiol.*, 1905, ii, 541; Lyman, Am. J. Physiol., 1913, xxxii, 62; Magnus, *Arch. f. d. ges. Physiol.*, 1904, cii, 130; and Dixon, J. Physiol., 1902, xxviii, 59.
38. ALVAREZ. J. Am. M. Ass., 1915, lxxv, 288.
39. MOORE. *Surg., Gynec. & Obst.*, 1908, vi, 282. *Brit. M. J.*, 1892, ii, 1049.
40. WEEKS. J. Am. M. Ass., 1916, lxxvi, 1022.
41. WALKER. Am. J. Obst., N. Y., 1906, liv, 722. J. Am. M. Ass., 1915, lxxv, 1184.
42. MCPHERSON. *Bull. Lying-in Hosp.*, N. Y., 1917, xi, 118.
43. ALONZO CLARK. *Pepper's System of Medicine*, Phila., 1885, ii, 1142.
44. TAIT, LAWSON. *Brit. M. J.*, 1892, ii, 1048.