

Intestinal Autointoxication: A Medical Leitmotif

Thomas S. N. Chen, M.D., and Peter S. Y. Chen, M.D.

The idea that putrefaction of the stools causes disease, i.e., intestinal autointoxication, originated with physicians in ancient Egypt. They believed that a putrefactive principle associated with feces was absorbed into the general circulation, where it acted to produce fever and pus. This description of the *materia peccans* represented the earliest forerunner of our present notion of endotoxin and its effect. The ancient Greeks extended the concept of putrefaction to involve not only the residues of food, but also those of bile, phlegm, and blood, incorporating it into their humoral theory of disease. During the 19th century, the early biochemical and bacteriologic studies lent credence to the idea of ptomaine poisoning—that degradation of protein in the colon by anerobic bacteria generated toxic amines. Among the leading proponents of autointoxication was Metchnikoff, who hypothesized that intestinal toxins shortened lifespan. The toxic process, however, was reversed by the consumption of lactic acid-producing bacteria that changed the colonic microflora and prevented proteolysis. The next logical step in treatment followed in the early 20th century when surgeons, chief among them Sir W. Arbuthnot Lane, performed colectomy to cure intestinal autointoxication. By the 1920s, the medical doctrine fell into disrepute as scientific advances failed to give support. However, the idea persists in the public mind, probably as an extension of the childhood habit of toilet training.

Key Words: Intestinal autointoxication—Stools—Putrefaction.

Intestinal autointoxication is the medical doctrine that diseases arise from the absorption of putrefactive toxin(s) from the intestine. Although the term was coined by Bouchard in 1884 (1), the theory has appeared, in one guise or another, from ancient to recent times.

ANCIENT FORMULATIONS

In ancient Egypt, physicians believed that the noxious agent, *wḥdw*, the putrefactive principle associated with feces, was the cause of disease (2). Absorption of *wḥdw* into the vascular system resulted in coagulation of blood and a sequence of events that accounted for the suppuration of certain diseases. The passage of *wḥdw* from feces into the general circulation produced heat and increased pulse, a “rising” that recalled the Hippocratic concept of fluxion and which was associated with the generation of fever (Figs. 1 and 2). This formulation was a remarkable presage of our present understanding of endotoxin and its systemic effect! The accumulation of *wḥdw* with progressive age led to the inescapable decay of the body. The idea of a putrefactive agent probably originated from the Egyptian practice of mummification. Religious belief prompted the ritual burial of the dead in which the body was preserved for the life after death. The procedure of mummification gave ample opportunity to observe the decomposition of the poorly preserved body. The malodorous emanation from the intestine of the decayed body suggested a link between putrefaction and fecal material, from which followed the deduction that disease and putrefaction were connected. To rid the patient of *wḥdw*, the Egyptian physician resorted to the use of purgatives. The Greek historian Herodotus reported the practice: “for three successive days in each month they purge the body by means of emetics and clysters, which is done out of a regard for their health, since they have a persuasion that every disease to which men are liable is occasioned

From the Department of Pathology, East Orange Veterans Administration Medical Center and the UMDNJ-New Jersey Medical School, Newark, New Jersey (T.S.N.C.), and the Department of Radiology, Saint Vincent's Medical Center and the University of Massachusetts Medical School, Worcester, Massachusetts (P.S.Y.C.), U.S.A.

Address correspondence and reprint requests to Dr. Thomas Chen (113), V.A. Medical Center, East Orange, NJ 07019, U.S.A.

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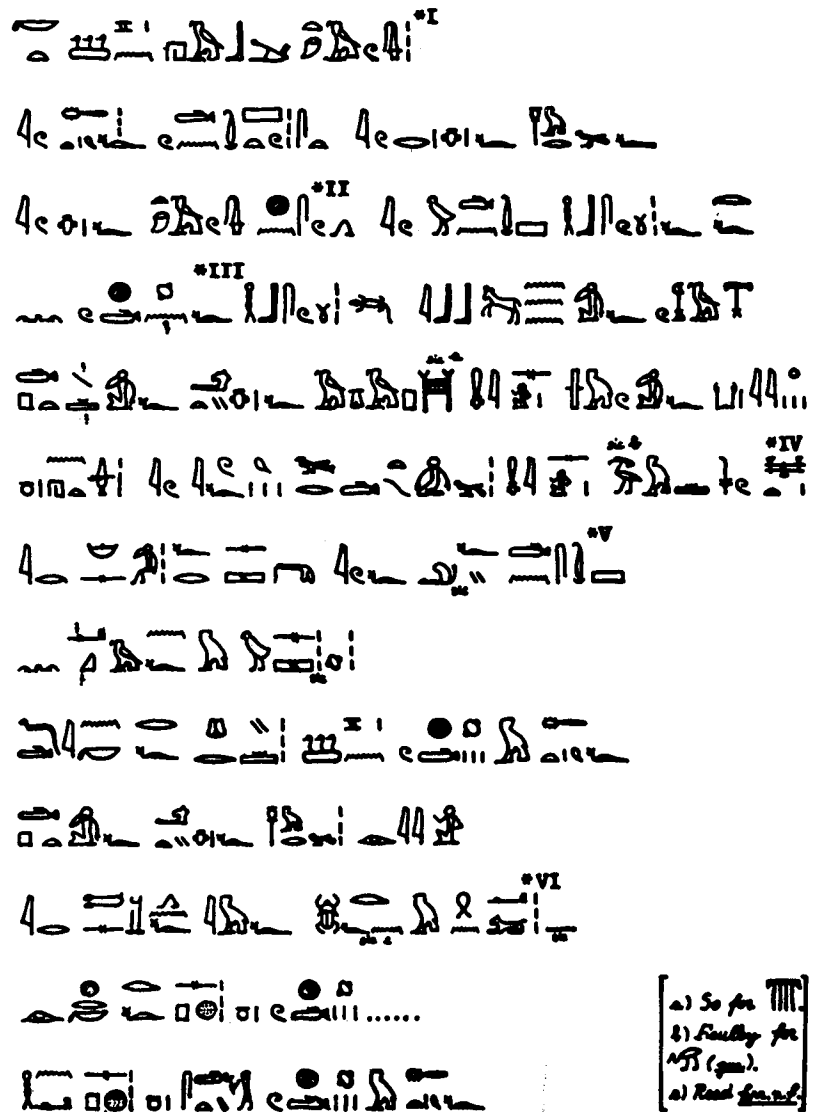


Fig. 1. Egyptian hieroglyphic text describing the systemic effect of whdw. [Reproduced with permission from (2).]

by the substances whereon they feed." (3). Blood letting was another accepted method of removing toxic material from the body. Egyptian medicine thus provided a rationale for the two procedures, enema and venesection, both of which have flourished in the therapeutic armamentarium.

The influence of Egyptian medicine spread to its Grecian neighbors. The impact on early Greek medicine could be found in the teachings of Cnidian School, which rivaled the Hippocratic School of Coas during the fifth century BC (4). The Cnidian physician adopted the putrefactive principle that disease arose from the residues or "superfluities" of food not completely digested. Euryphon, the founder of the school, wrote: "When the belly does

not discharge the nutriment that has been taken, residues are produced, which then rise to the regions about the head and cause disease. When however the belly is empty and clean, digestion takes place as it should. . . " (5). The early Greeks, however, also believed that residues may originate not only from the decomposition of food, but also from bile, phlegm, and blood, each of which may result in disease. Putrefaction per se played both a physiologic and pathogenic role in digestion (6). The digestive process occurred in two stages: in the upper belly and then in the lower part of the abdomen. The first stage lasted 2 days, during which food was transformed by concoction, a putrefactive process that was akin to fermentation.

*Another [prescription] against a pool [of whdw] generating fever;
 his [the patient's] body is heavy, his r3 tb (cardia? pylorus?) is sick;
 his heart is hot, it pulsates;
 his covers are heavy on him;
 he cannot stand many covers;
 he suffers thirst at night
 and he tastes [feels] his heart oppressed
 like [that of] a man who has eaten fruits of the sycamore(?) tree;
 his flesh is weak like [that of] a man whom the road has found.
 If he crouches in order to evacuate
 (then) his intestines are under pressure
 (but) he is not getting along with the evacuation.
 Thou shouldst say to him [i.e., concerning such a case];
 This is one who is under a pool of whdw in his body;
 he tastes [feels] his heart;
 he is sick [and] I shall act (on his behalf).
 Should it rise in him and become an occlusion
 you will have to apply [to him]
 remedies against whdw, together with remedies to
 destroy whdw.²⁰*

Fig. 2. Translation of the Egyptian text. [Reproduced with permission from (2).]

Food underwent further transformation into feces and urine during the second stage, which was completed on the third day. However, not all the food was digested, and putrefaction accrued. When the normal cycle of digestion exceeded 3 days, the state of retention led to a disproportion of humors, fever, and disease. Although the physiologic meaning of the several steps in digestion was not clear, the idea remained that putrefaction acted favorably in initiating the process of the transformation of food, and unfavorably, whenever it accumulated, as a *materia peccans*. Another biologic role for putrefaction was suggested by Aristotle (fourth century BC) when he theorized that putrefactive material, such as stagnant water, mud, and sand, was a source of spontaneous generation (7).

GALEN

The Greek concept of putrefaction reached its height of development in the writings of Galen (second century AD). Galen broadened the concept of residues to include the waste products of organs other than the intestine: "After we eat and drink, we are once compelled to provide for the evacua-

tion of the residues. And since there are many varieties of these residues, some from the food digested in the stomach, some from that in the liver and arteries and veins, and some from every part, presumably it is necessary that their evacuation be individual to each." (8). Individual organs produced wastes such as sweat, mucus, and vapors, which, if not eliminated by proper digestion and evacuation, would undergo putrefaction. The process generated heat, a fever that involved the entire body by corrupting the humors. Galen wrote: "abnormal heat in the bodies first putrefies and corrupts the humors on account of their humidity and after a time attacks the fat and flesh" (9). Therapy was directed to opening the normal routes of evacuation and preventing the retention of putrid humors. Among the valuable procedure was blood letting, particularly in febrile conditions.

Galen extended the biologic role of putrefaction in his concept of miasmas. Miasmas were putrefactive particles transmitted through the air and exhaled by those with pestilential conditions. Epidemics arose when contagion spread by inhalation contact with patients with pestilential fevers. Conditions such as spoiled food and poor housing promoted the development of such fevers. Galen's concept of the miasmas proved to be one of his enduring contributions to medicine, surviving with modifications until the 19th century.

For the ancient Greeks, digestive residues represented just one of the several mechanisms of disease. The dominant theory of disease origin postulated a dynamic change in the equilibrium of humors without putrefaction being primarily involved. Greek thinking along Galenic lines became the ideologic basis of Western medicine for the next millennium and a half.

18TH CENTURY REVIVAL

The idea of intestinal autointoxication surfaced in the 18th century, an age of competing theories of medicine, when Johann Kampf (died 1753) advocated the doctrine of infarctus. By infarctus he meant impacted feces originating in the humors in portal vessels and in the intestine, "when the former become filled, stuffed and distended . . . by blood delayed in its circulation and finally stagnant, coagulated . . . variously corrupted, robbed of its fluidity, thick viscous . . . or when the thickened serum of the same, in the glands, the cellular tissue, and the digestive passages, accumulates, putrifies, dries, and takes on many kinds of decomposition" (10). Kampf distinguished two types of infarctus:

the black-bilious and the mucous, which was of varying consistency. To eliminate the dangerous product, "visceral-clysters" were recommended and were performed as frequently as three times daily. The fashion of visceral clysterization became widespread among the upper social class in France; the procedure was satirized by Moliere in his play, *Le Malade Imaginaire*. Other physicians presented autointoxication in less humoralistic terms. For example, von Haller (1765) held "that in constipation foul water was absorbed from the feces and filling the blood with rancid parts produced fever, hemorrhage, consumption and insanity" (11).

19TH CENTURY

During the latter part of the 19th century, the concept of intestinal autointoxication acquired a veneer of scientific respectability. The developing fields of bacteriology and biochemistry gave the concept a renewed lease of credibility. On one hand, the new laboratory techniques confirmed that specific bacteria may produce toxins in the intestine that accounted for the systemic and local features of disease, such as botulism. On the other, they provided findings that lent support to the theory of intestinal autointoxication. The modern formulation of the theory was first expressed by H. Senator (1868), who hypothesized that the putrefactive decomposition of proteins in the intestine under normal conditions produced toxins harmful to the host (12). L. Brieger (1878) observed that after ingestion of tyrosine, phenol excretion in the urine increased (13). He also measured other products of amine metabolism in the urine, naming them protamines. He believed that absorption of the metabolites of protein breakdown by anerobic bacteria in the colon was harmful. Ptomaine poisoning became a catch-all term to cover various causes of gastrointestinal upsets and systemic diseases (14). Among the latter was chlorosis, now a discarded entity. According to A. Clark (1886), constipation due to tight corset lacing, insufficient diet, and irregular bowel habit led to excessive formation of ptomaines, which destroyed the erythrocytes in circulation (15).

C. Bouchard (1884), who coined the term intestinal autointoxication, proposed that the degree of toxemia could be estimated from the amount of etheral sulfates excreted in the urine. He believed that colonic stasis was not injurious, rather "constipation ought to be regarded as a protection against autointoxication," as bacteria tended to die out in dry, hard feces. Bouchard explained that "in constipation there is, at first, a preliminary phase, in

which appears a threatening of intoxication, but, in the second phase, intoxication is no longer in operation . . . Besides, are constipated people healthy? They have headache, migraine, and vertigo. Hypochondriacs, whose sufferings are chiefly subjective, are constipated . . . all the insane are constipated, and alienists endeavor specially to guard against constipation" (16). Intestinal autointoxication occurred in "chronic diarrhea, in cancer of the stomach or intestine, in chronic dyspepsia and above all, dilation of the stomach." Bouchard underscored the latter disorder: "assuredly, one can have a large stomach and experience dyspeptic troubles, but he is the victim of disturbances in the elaboration of food. Men whose stomach is dilated complain of their indisposition as being of very slow development; they are, nevertheless, ill for a long time before becoming patients. Their diseases are, therefore, diseases of debility, because the alimentary material, incompletely digested and undergoing putrid fermentation, is no longer sufficient for their nutrition . . . we notice, then in individual who presented the physical signs of dilation of the stomach. 1. Pulmonary phthisis. 2. Chlorosis . . . 3. Nervous or hypochondriac symptoms . . . 4. Lastly, other symptoms, so varied and so numerous that their mention at first provokes incredulity" (17). Bouchard found that charcoal, naphthalene, and iodoform reduced the toxicity of the stool and urine. He attempted to cure cases of autointoxication by disinfecting the intestine with β -naphthalene. This started the use of antiseptics to reduce putrefaction in the intestine. F. Muller (1887), among others, confirmed that various antiseptics could reduce the urinary excretion of etheral sulfates (18).

METCHNIKOFF

E. Metchnikoff further popularized the doctrine of autointoxication with his simple thesis that "in the legacy acquired by man from his animal ancestors, there occur not only rudimentary organs that are useless or harmful, but fully developed organs equally useless. The large intestine must be regarded as one of the organs possessed by man and yet harmful to his health and his life. The large intestine is the reservoir of the waste of the digestive processes, and this waste stagnates long enough to putrefy. The products of putrefaction are harmful. When faecal matter is allowed to remain in the intestine, as in the case of constipation, a common complaint, certain products are absorbed by the organism and produce poisoning, often of a serious nature. Every one knows that a high tem-

perature may be the result of constipation in woman after childbirth, or in patients recovering from an operation. This is due to an absorption of substances produced by the microbes of the large intestine. Similar products may be the cause of an attack of acne or of other skin diseases. In fine, the presence of a large intestine in the human body is the cause of a series of misfortunes." (19). Metchnikoff's notoriety reached a zenith when he proposed (1907) that premature aging was due to intestinal toxemia and that this could be prevented by altering the microflora of the gut. He speculated that longevity in animals varied inversely with the length of the large intestine, where feces retained for a long period becomes a nidus for the growth of putrefactive microbes (20). Metchnikoff deduced that intestinal putrefaction shortened lifespan. He found that races who lived long shared one thing in common: consumption of sour milk. His experiments revealed that it was lactic acid in milk that inhibited the proteolytic action of intestinal bacteria. Metchnikoff recommended that consumption of milk soured by *Bacillus bulgaricus*, a lactic acid producer, not only prevented intestinal proteolysis, but also prolonged life. The dietary regimen seized the public's imagination and led to such a frenzy in England that an editorial commended: "For several months one heard nothing but of the Bulgarian bacillus. The bacillus shared with Mr. Lloyd George's budget the honor of monopolizing the conversation at the dinner tables of the great. He dominated Belgravia, frolicked in Fulham, and bestrode Birmingham and the whole of the British Isles. Whether he did any good to any one except the chemists and the purveyors of milk there is some reason to doubt. That he himself, or a colorable imitation of him, which was put on the market by the unscrupulous, did a great deal of harm is quite certain. But the harm done was mostly to the self-prescribers or to those introspective idiots who allow themselves to be treated by their lady friends." (21).

ERA OF SURGERY

The treatment of intestinal autointoxication turned radical with the arrival of the 20th century. Perhaps the best-known proponent of the therapeutic extremism was Sir William Arbuthnot Lane (1856–1943) (Fig. 3). Widely acclaimed by his peers as a surgical pioneer, Lane was equally adept in open reduction of simple fractures, early closure of cleft palates, and excision of the jugular vein. He achieved successful surgical results by meticulous devotion to the no-touch technique. With long in-

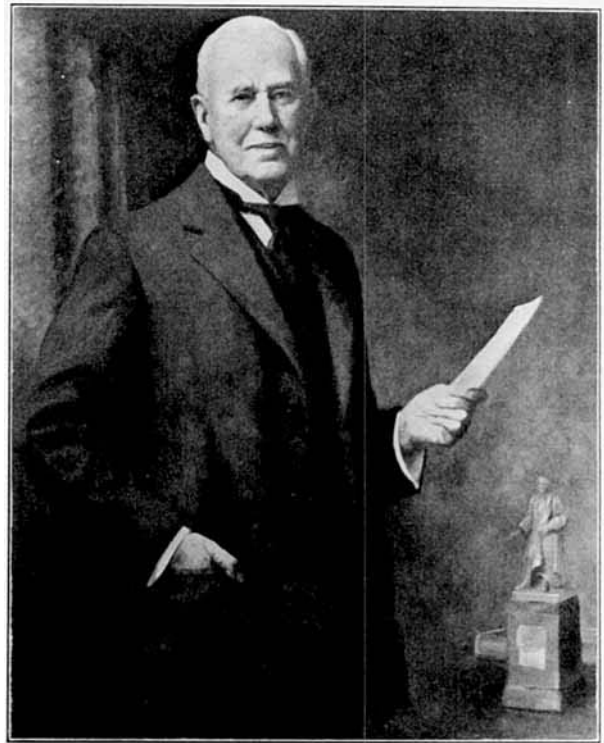


Fig. 3. Sir W. Arbuthnot Lane (1856–1943). The portrait is taken from the painting by Captain Newling. The statuette is of Thomas Guy, who founded Guy's Hospital in 1725. [Reproduced with permission from (22).]

struments that he devised, Lane operated at a distance from the lesion thus allowing for maximum asepsis and minimal trauma. Above all, he advocated bypass procedures for chronic constipation. Starting with ileosigmoidostomy in 1893, a year before he met Metchnikoff, Lane later performed colectomy for chronic intestinal stasis, which on the Continent became known as Lane's disease. His endeavors in this area prompted a satiric ditty which ended thus:

Columbus discovered America
Sir Alfred discovered the King
And Arbuthnot Willie discovered the cause
Of eyes with black shadows
And cold clammy paws (22)

Lane defined chronic intestinal stasis as "such a delay of the contents of intestines in some portion of the gastrointestinal tract, but more particularly in the large bowel, as allows of the absorption into the circulation of a larger quantity of toxic material than can be dealt with effectually" (23).

The topic of intestinal stasis became for Lane an intellectual bete noir. It was, as he stated, "the dominant factor in medicine being the basis of all

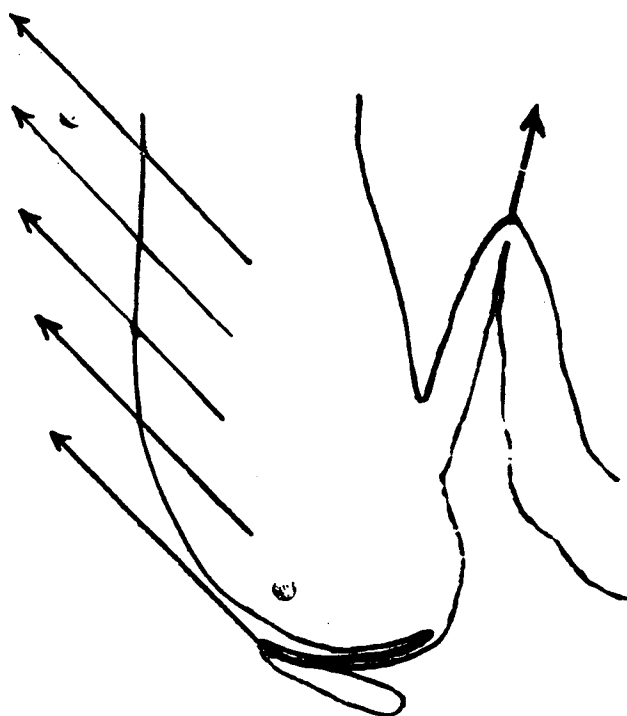


Fig. 4. Lane's concept of the mechanical force and adhesion formation. Diagram indicates peritoneal adhesions opposing the downward displacement of the loaded cecum. The last adhesion is attached to the appendix.

morbid conditions peculiar to a state of civilization, and that the greatest duty that devolves on the members of our profession is by obviating its development to prevent disease" (24). Intestinal stasis had its origin in the present condition of civilization when man assumed the erect posture and restricted his bowel movement to once a day. The upright position predicated a constant tendency of the viscera to fall within the abdomen. Adhesions and ligaments formed along lines of resistance to oppose the downward displacement of the organs (Fig. 4). These bands offered obstruction to the fecal flow in the intestines. Of the several kinks that developed in the gastrointestinal tract, two loomed large in Lane's mind. The first occurred in the ileocecal region, where adhesions prevented prolapse of the cecum into the pelvis (25). The resultant kink became known as Lane's (or ileal) kink and was widely accepted as a cause of chronic intestinal stasis (Fig. 5) (25). The pericecal adhesions may also involve the appendix, where kinking led to attacks of appendicitis. A second and even more important kink affected the descending colon where it crossed the pelvic brim and where a band formed to prevent backward passage of the feces (26). This

first and last kink, the first because it developed very early in life and the last because none existed below it, was "by far the most important evolutionary structure in the human body which has ever been observed and one that is productive of the most disastrous consequences. It is a regular Pandora's box." (24). Lane based his conclusions on anatomical findings and reasoning from the principles of mechanics. He also found support from radiological observations that patients with alleged intestinal stasis showed a delayed pattern of evacuation after a bismuth meal (27).

Lane postulated that the civilized habit of one bowel movement a day and the lack of dietary roughage promoted the delay in the passage of feces. The symptoms of chronic intestinal stasis fell into two groups: mechanical effect leading to distention, pain, and ulceration of the gut, and general manifestations due to absorption of circulating toxins (28). The systemic features included skin changes, such as wrinkling, staining, and increased sweating, and low blood pressure, accompanied by cold and clammy extremities. The temperature was often subnormal. The patient showed loss of fat and muscle, giving rise to an appearance of senility. The mental aberrations encompassed a large list: apathy, irritability, depression, headaches, stupidity, and even dementia. Lane's critics counted 17 general symptoms and 9 diseases attributable to intestinal stasis (29). The diseases, including tuberculosis, rheumatoid arthritis, and thyroid disorders, resulted indirectly from autointoxication, which provided the "necessary antecedent factor" for the pathogenesis of these conditions. Lane proposed that rheumatoid arthritis and the other disorders may also respond to ileocolostomy with or without colectomy (30). He reduced the operative risks by instituting two measures: the infusion of saline into the axilla of the patient and the insertion of an esophageal tube into the rectum. The two precautions diminished the complications of shock and ileus. Lane recognized that intestinal stasis may also be prevented by the use of corsets (the Curtis abdominal belt), especially among women (31), and laxatives. He preferred paraffin oil as the laxative of choice, which he himself took on a daily basis and to which he attributed his longevity. "Paraffin and a belt" was a slogan used by the followers of Lane.

CODA

The Pandora box of intestinal stasis opened a wide field of investigation for both supporters and detractors [for an excellent review of the experi-



Fig. 5. Lane's kink with adhesions at the terminal ileum.

mental work, consult the paper of Alvarez (32)]. For the biochemists, the products of protein digestion—indol, skatol, phenol, and pressor bases—became the putative toxin(s). The microbiologists incriminated a host of proteolytic anaerobes in the genesis of intestinal putrefaction (33). The pathologists postulated that latent infection or subinfection due to an influx of bacteria in small numbers from the intestine accounted for the tissue effects of autointoxication (34). The nutritionists discovered that diets may change the colonic microflora to one dominated by the fermentative type of organisms. The radiologists sought to confirm the presence of intestinal stasis with x-ray studies with bismuth and other radioopaque material (35). Clinicians studied the delay of emptying of the bowel in patients with constipation, using markers for transit time such as charcoal. By the 1920s, the scientific substructure that appeared to support the hypothesis of intestinal stasis crumbled when researchers adopted more rigorous approaches and refined techniques (36, 37).

The various disciplines that initially lent credence to Lane's Pandora box had by their very own advances invalidated the medical credibility of intestinal autointoxication. None of the putative toxins was found to be absorbed from the colon, to be harmful on ingestion in humans, or to escape inactivation by the liver. Latent infection disappeared as a cause when bacteremia could not be detected from the normal colon. Radiologic and transit studies did not confirm a consistent pattern of delay. The surgical success obtained by Lane could not

withstand the scrutiny of statistics nor was it repeated in the hands of others. Perhaps the most decisive experiments were those performed by Alvarez (38) and Donaldson (39). Both showed that the discomfort and the local symptoms attributed to constipation could be reproduced by distention of the rectum with packing of inert material. There was thus no need for invoking autointoxication to account for the symptoms of chronic constipation.

Although in disrepute, the leitmotif of intestinal autointoxication has not vanished. Witness the constant advertisements and vast expenditures for the purchase of laxatives. It remains imbedded in the minds of the public and some physicians. Both groups still practice ritual purgation for a variety of conditions that have very little connection with delayed emptying of the bowel (40). The survival throughout the centuries suggests a deep-rooted existence in the human psyche, for which Freudian psychology supplies a plausible explanation. According to Freud, most infants find pleasure in moving their bowels (anal eroticism) (41). This pleasure is curbed during childhood when toilet training takes precedence and evacuations are performed according to schedule. A conflict arises between the child and parent over the control of defecation, and the idea is generated that soiled feces are dirty and contaminating. The practice of toilet training assigns a positive value to the mastery of defecation and a negative one to the contents of the colon. The merits and pleasure of bowel movements and the corresponding evil of retention are carried over in the adult mind. The concept of

intestinal autointoxication evolves as the extension of the learned habits of childhood. Whatever its origins, the notion of the harmful stools in constipation is unlikely to disappear.

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