

# The Journal of the American Medical Association

Published under the Auspices of the Board of Trustees

VOL XLVI.

CHICAGO, ILLINOIS, JANUARY 27, 1906.

No. 4.

## Addresses

### THE PRESENT STATUS OF THE SURGERY OF THE STOMACH.\*

WILLIAM D. HAGGARD, M.D.  
NASHVILLE, TENN.

The triumphs which surgery has achieved over certain diseases of the stomach comprise one of the most useful and gratifying experiences which has crowned the efforts of our profession in the last decade. It has demonstrated anew that, as the hand-maiden of medicine, surgery is ever widening the limits of its helpfulness and adding new luster to its already brilliant achievements.

The stomach is probably the most important viscus in the body from a surgical standpoint. It is more prone to pathologic changes that can be relieved by operation than any other portion of the alimentary tract, save its terminus. Interference with its functions are attended with the most distressing and serious results. The relative safety with which it can be exposed and manipulated goes far to render it attractive for needed surgical exploration. Its thick walls and peritoneal investment make it well adapted to suturing, and wounds and incisions can be closed with ease and security. With the perfection which the details and accessories to surgical work have been brought in other departments, the comparatively recent innovations in the surgery of the stomach have been undertaken with a precision which has not obtained in the opening up of other new fields in the surgical domain. The mortality in the hands of the expert has been so minimized that operation can be consistently advocated for the relief of distress and disability as well as for immediate and remote danger.

The modern surgery of the stomach is not more than four or five years old, and in its more perfected aspect is only half that old. Its results, judged by statistics before that time, are not comparable to its present accomplishments and the oft-repeated reference to its "frightful mortality" should give place to the recognition of its present surprisingly low death-rate. The discussion, relative to operation for stomach lesions now, is similar to that in regard to appendicitis twelve or fifteen years ago. Then only the desperate cases were submitted to operation. It is so now with many stomach cases. This, however, must yield to the logic of results and in a short time the profession generally will advise early operation as they now well-nigh universally do in appendicitis. Improved technic, low mortality and satisfactory end results will inevitably do away with the empirical treatment of occult intractable stomach troubles. Operating-room demonstration of pathology *in vivo* is impressing the easy mechanical relief of these lesions. A

closer intimacy with living pathology will instill the lesson which we have learned so well in other portions of the body, where the golden opportunity is no longer permitted to slip away.

The laity, too, will soon become educated on the subject, and will criticize us for allowing a chronic ulcer to go on to perforation or fatal hemorrhage and for permitting cancer to stealthily creep upon its unsuspecting victim without early recognition. They did that with cancer elsewhere, with delayed operations for appendicitis and with the occurrence of puerperal sepsis, and in my opinion the laity had a very strengthening influence in seconding our efforts to prevent these catastrophies.

Penzoldt appeals for a closer union of surgical skill and internal diagnosis, and says it promises more for patients with a stomach trouble than for any other morbid condition. He says:

It is the duty of every practitioner who has not the fortune to possess the necessary experience for performing these operations to call into consultation a surgeon possessing the necessary skill so soon as the question of any operation arises. Above all, it behooves the physician who practices as a specialist in the domain of stomach and intestinal diseases, and to whom a great number of uncured patients are sent, to come to a definite agreement on the grounds for operation with an experienced surgeon; the unavoidable disadvantages arising from the unnatural division of practice into surgery and medicine may by such a personal union be compensated.

Moreover, he warns physicians that although there may be a good deal of difficulty in acquiring the necessary skill in the diagnosis of stomach diseases, this is far easier than that required to perform the necessary operations, and that if physicians do not co-operate with surgeons the latter will find the means of acquiring the diagnostic skill and do without them. He complains, too, of the "hesitation and faint-heartedness" of many practitioners which he thinks constitute an unjustifiable obstacle to the progress of surgical treatment (Saundby).

Granted the diagnosis, the surgical problem has just begun. The literature abounds in most complete and exhaustive memoirs. Surgical inquiry and activity in this field is everywhere rife. Various methods have been employed. The technic is constantly changing. The ingenuity displayed in the planning of operative methods is really wonderful. The discarding of the unessentials is very striking. Simplification of mechanics and technics seems to be the desideratum. Mayo is working on a new plan in gastro-enterostomy which tends to simplification and, it is believed, to better mechanics. It is not untimely, however, in this presence to invoice the present attitude of advanced professional thought and epitomize the recognized methods of to-day. I will endeavor, therefore, to present some facts which I believe faithfully portray the present status of the surgery of the stomach.

\* The address in Surgery before the Mississippi Valley Medical Association, Indianapolis.

The typical indication for operative interference is obstruction of the pylorus from an open or cicatrized ulcer causing dilatation of the stomach with stasis of food. The short-circuiting operation of gastro-enteric anastomosis finds its ideal indication here and has given most beneficial results. It is the *fons et origo* of the present group of drainage operations, as well as other gastric procedures, and is altogether the most perfected and satisfactory employed operative device.

The complications of ulcer requiring operation are (1) perforation and (2) hematemesis of chronic ulcer. Hemorrhage from an acute ulcer is rarely fatal and is usually amenable to dietetic treatment.

It is often the first symptom of acute ulcer, but rarely occurs in that relation to chronic ulcer and makes its advent most often between the first and fifth years of the disease. It occurs in 18 per cent. of all cases (Fenwick), causes death in 8 per cent. of those in which it does occur (Rodman), and is the determining cause of death in from 3 to 5 per cent. of all cases (Welch).

Operation is advised in repeated acute hemorrhage or in constantly recurring small hemorrhages.

Other indications are found in the following groups of cases: (3) Obscure and persistent stomach symptoms with a long history of dyspepsia culminating in hemorrhage, after it has been controlled by medical means and the patient put in the proper condition for operation (Cabot). (4) Cases of chronic intractable dyspepsia even without dilatation which fail to yield to proper medical treatment and are not due to general visceral ptosis.

Waterhouse says that unless definite improvement manifests itself after three months of medical treatment of chronic ulcer or all serious symptoms have not disappeared after six months' treatment the case should be considered one for surgical, rather than for continued medical aid.

Other authors specify operation in cases in which "three" systematic ulcer cures have not cured, and a prominent surgeon facetiously remarks in reference to these cases that operation is contraindicated unless the patient has had as many as nine permanent and complete cures. The greatest desideratum in gastric surgery is operation in the early stages of cancer, and hence in enumerating the indications it may be summarized in the phrase (5) "on suspicion of cancer." A synopsis of the other stomach conditions for which operation is recommended is as follows:

- (6) Disabling perigastric adhesions.
- (7) Congenital stenosis of pylorus.
- (8) Fistula between stomach or pylorus and adjoining organs or even with the surface of the body.
- (9) Hour-glass stomach.
- (10) Congenital hour-glass stomach (Brooks).
- (11) Volvulus.
- (12) Tetany due to obstruction and dilation (Cunningham).
- (13) Spasm of pylorus (Reichmann's disease).
- (14) Subphrenic abscess.
- (15) Perforating wounds of stomach.
- (16) Non-perforating trauma (Monprofit).
- (17) Cirrhosis (Sheldon).
- (18) Foreign bodies.

It will be seen that, aside from malignancy, chronic ulcer and its complications furnish most of the indications and the majority of cases. Indeed, it is not impossible that the bulk of cases of inveterate dyspepsia are really due to ulcer. That it is found postmortem so very many more times than it is recognized clinically is

a reproach not so much to our diagnostic measures as to our failure to properly apply them.

The necropsy incidence in Philadelphia was 3.15 per cent.; in London, 4.6 per cent.; in Europe, 8.54 per cent. Mikulicz says: "The dangers to life from gastric ulcer is at least not less, but probably far greater than the danger of a complete modern operation." Riegel estimates the mortality at 8 to 10 per cent., Lebert at 10 per cent., Welch at 15 per cent., von Leube at 25 per cent., Debove and Raymond at 50 per cent.

Aside from its immediate and remote mortality (anemia, tuberculosis, malignant degeneration, etc.), the ease, frequency and permanence of cures are greatly overestimated. In a consideration of the permanent cures it must be borne in mind that amelioration of acute symptoms does not necessarily mean an actual cure, and some of the patients so cured may and do die later of perforation, hemorrhage, canceration and other complications, and 40 and 45 per cent., respectively, in two different series of cancer cases represented a good history of preceding ulcer (Mayo and Graham).

As bearing on permanence of cure, Russell studied 89 cases of gastric ulcer, covering a period of 7½ years; 44.7 per cent. were found to be suffering from stomach symptoms at the last report, 14.9 per cent. were having repeated and definite attacks with intervals of immunity, and 29.8 per cent. suffered almost continuous pain. Another group of 6 per cent. could not as yet be classed with the uncured, 44.7 per cent. Contrast this very lame showing to the graphic description and beautiful results of Moynihan:

Indeed, I do not know any operation in surgery which is more successful or which is attended by better or more striking results than gastro-enterostomy for chronic ulcer of the stomach. A patient, thin, shrunken, cadaverous and gloomy in aspect, who has been chiefly occupied in trying to avoid acute attacks of indigestion or vomiting, whose whole attention is concentrated on his stomach, who considers every article of diet carefully before he takes it and by degrees abandons first this dish and then the other until he is finally reduced to fluids alone, who, indeed, has never conceived that any other question than that of his own health could seriously interest him, a patient, to say the truth, whose whole existence has been ordered and regulated by his stomach, finds, after a gastro-enterostomy has been performed for his chronic ulcer, that he can eat what he likes in any quantity he likes, that he rapidly puts on weight, and that his general sense of well-being is almost beyond belief. From being a misanthrope he becomes an enthusiast and an optimist. I have often wondered with a certain amusement what would have been the result of a timely gastro-enterostomy on Thomas Carlyle. He might have taken to the writing of comedies and threatened the throne of Congreve. And his portrait, twelve months after the operation, viewed side by side with that done by Whistler, would have proved an eloquent advertisement for his surgeon.

The ulcer is recognized at operation by its shot-like feel or when the walls are picked up between the finger and thumb the muscularis does not slip off the mucosa. a milky white spot often denotes its site and the enlarged "sentinel gland" of Lund may be found in the greater or lesser omentum. Very often the thick-based, indurated ulcer is so prominent that "he who runs may read" and is situated at or near the pylorus. The induration or contraction may have caused obstruction and consecutive dilatation.

The first four inches of the duodenum is embryonically, physiologically and surgically a part of the stomach. Duodenal ulcer, therefore, does not differ etiologically from it. It is most frequent in men, and in the fifth decade of life. It occurs often in the professional

classes who live too well and develop hyperchlorhydria. It is characterized by pain an hour before meals or in the early morning hours and relieved by food. Malena is frequent. It is relatively very much more frequent than has been supposed. In a period of  $2\frac{1}{2}$  years the Mayos found, out of 231 cases of gastric and duodenal ulcer, the duodenum to be involved 2 times, or 32 per cent. In 42 operations for chronic duodenal ulcer he had only a single death. It is exceedingly prone to perforate and takes place usually in men in the prime of life, with perhaps little or no stomach symptoms. Murphy says perforating duodenal ulcer is practically impossible to diagnose accurately without exploratory laparotomy. As a most remarkable series of cases I will quote Turner, who saved 8 out of 9 cases at St. George's Hospital. They were operated on 4,  $5\frac{1}{2}$ , 10, 12, 17, 24 and 48 hours, respectively, after onset of symptoms. The only unsuccessful case was operated on the third day, when practically moribund.

D'Arcy Powers gives the following forceful description of a typical example of chronic duodenal ulcer:

He tells you that he is a martyr to indigestion, and that for months past he has suffered atrocious pain in his stomach, which is relieved by vomiting. He has dieted himself in every possible manner, he has made all kinds of local applications to his abdomen, he has visited all sorts of watering places, and he has gone in vain from one physician to another seeking a cure. Examination shows him to be a mere bag of bones, badly constipated, cold extremities, and a listless, dejected aspect. His abdomen is loose, the subcutaneous veins dilated, and a visible peristalsis from left to right in the epigastric region. Percussion tells you that the stomach is greatly dilated, and it is not very unusual to feel a tumor in the neighborhood of the pylorus or gall bladder, and you question the patient a little more closely. He is sure that he has been suffering for years, for so long, in fact, that he hardly recollects the beginning of his trouble. A few well-directed inquiries may elicit that twenty-five or thirty years ago, when he was a young man, he once or twice brought up a large quantity of blood without serious pain or discomfort, or that he had an illness which no one seemed to know much about. He was treated for gallstones, or appendicitis, or simply for "liver." The attack was painful and kept him in bed, but the exact details have passed from his mind, and for some years he was as healthy a man as ever.

This is a case of duodenal obstruction resulting from cicatrization of an old ulcer, the irritation of which has caused inflammatory thickening in the surrounding parts. How many patients have been allowed to die of such a condition in the belief that they had malignant disease of the stomach no one can tell. But for such patients a gastrojejunostomy holds out the prospect of a speedy and perfect cure.

It is in duodenal or pyloric obstruction that gastroenterostomy finds its most exquisite indication and attains its highest efficiency.

The many various methods for performing gastroenterostomy give a feeling of wonder at the ingenuity displayed. It is probable that the ideal method has not been finally arrived at. The relative safety of the operation even by varying technic is illustrated by Robson's results—over 200 cases, with a mortality of 3.6 per cent. The posterior operation has largely supplanted the anterior, because of the avoidance of the loop around the transverse colon, and the mischief which it caused. The anterior operation is reserved for malignancy where the speediest technic is the best, where the stomach can not or should not be delivered freely, and the operation is palliative in its intent. The Murphy button, to which we owe most of the knowledge we have of gastric and intestinal surgery, can be employed here on account of its rapid insertion.

The McGraw ligature finds its best scope in such cases if an immediate opening is not required. Secondary jejunal ulcer is not likely to occur on account of the absence of HCl.

The vicious circle, which was formerly a *bête noir*, was due to angulation or obstruction by spur-formation. The posterior loop, eight or ten inches long, invites this more than any other method. It rarely occurs with the button, because of the rigidity at the anastomosis, which prevents kinking.

The posterior operation without the loop, with a longitudinal incision from one to three inches from the duodeno-jejunal angle, gives almost complete immunity from the vicious circle. This operation was described by Peterson in Czerny's clinic, has been recently popularized by Moynihan's writings and is practiced by the Mayos, who have come back to it after employing various other and more complicated and elaborate methods, including entero-anastomoses, with occlusion or division of the efferent limb. The essentials of the present perfected posterior operation are: (1) The selection of the very bottom of the stomach (Mayo); (2) the obliquity of the opening from above down and from left to right (Moynihan); (3) the utilization of the jejunum as it drops straight down and at a point where it normally lies in contact with the posterior wall of the stomach with only the mesocolon intervening (Petersen); (4) anastomosis effected with clamps and simple suturing with linen thread.

Peptic ulcer is not so likely to occur because the mucous membrane is better able to protect itself nearer the alkaline biliary and pancreatic openings.

This technic has enabled Moynihan to report 173 operations for benign conditions, with only two deaths. Mayo performed 307 operations by various methods, with 19 deaths ( $6\frac{1}{2}$  per cent.). In the last 140 there were only four deaths ( $2\frac{6}{7}$  per cent.), and in the last 80 by practically this method there was only one death. Mayo, for the last two months, has been making the anastomotic opening obliquely from above down and from right to left, instead of vice versa, as in "Moynihan's oblique line." Heretofore great consideration has been shown the line of peristalsis of the stomach, but Cannon and Blake have shown that, no matter where the opening is made, the stomach by its rhythmic, milking-like action makes the point of exit the lowest part of a spindle and ejects the food in jet-like movements.

All of our past trouble has been with the jejunal side of the anastomosis and not with the gastric. The right oblique opening is in more harmonious relation to the course of the jejunum at that point than the left oblique and prevents twisting the jejunum out of its right oblique direction into the left oblique.

I have employed this technic in three cases recently, with most ideal results so far.

The more complex methods, like Mumford's and Roux's, while most ingenious, are not believed to be more effectual than the simpler methods above outlined. The Roux method is excellent as a secondary operation when vicious circle has occurred.

The gastro-duodenostomy of Finney seems ideal and makes the pylorus capacious and is at the natural outlet. It is contraindicated where there is a large amount of scar tissue and immobility from extensive adhesions. The mortality reported by Mayo was 6.9 per cent. in 58 cases.

Excision of the favorably situated and apparently

solitary ulcer may be advantageously combined with it. There have recently been proposed a number of modifications of gastro-enterostomy.

1. Maury substitutes for the elastic ligature of McGraw a triangular stitch of twine which is effectual.

2. Gilbert uses a Pean forceps containing a sheathed knife to cut through the juxtaposed stomach and jejunum which are united by a continuous serous suture.

3. Werelius experimentally employed silver wire or thread introduced like McGraw's ligature and made to saw through the two adjacent walls when the suture is half completed.

4. Sato proposes to effect the opening by the application of  $\text{AgNO}_3$  after the seromuscular coats have been incised and then they are sutured as usual. The lumen is not opened primarily.

A most logical operation for gastric ulcer is that proposed by Rodman, of excising the ulcer-bearing area by a pylorotomy. This stops the possibility of hemorrhage, removes the lesion and cicatrices. This removes also all of the ulcers, as they are usually multiple and situated in the antrum pylori, which is also the cancer site. It removes any co-existing duodenal ulcer in the first two and one-half inches.

There are two classes of cases in stomach surgery that do not give good results: (a) Ulcer with an open pylorus, sometimes allowing the anastomosis to close, and invite the repetition of the ulcer; (b) the neurasthenic, that most-to-be-pitied of all non-fatal diseases. In surgery generally these cases are bug-bears and should be studiously avoided, except in cases of very extreme disability and unmistakable evidence of gross and serious pathology.

The most crying need in all medicine is some means for the early recognition of cancer of the stomach.

The early diagnosis of the other great scourge of mankind—tuberculosis—is satisfactory, but unfortunately there is as yet no radical cure for it.

If it were possible to diagnose gastric cancer in its very incipency, a very large number could be saved by operation. The anatomic and lymphatic conditions are favorable for an ideally early operation.

Until the magic and immunizing therapy which will convert malignancy into benignancy is discovered, extirpation is our only resource.

One-third of all carcinomata are in the stomach. The average duration of life is nine months. Diagnosis by medical means is usually too late unless it is made by a strong surmise and confirmed by exploratory incision. Laboratory methods are unavailing in the operable period, as no change has taken place in the secretions. Any obscure digestive case, where pernicious anemia is excluded, and especially if HCl is absent, demands exploration. Riegel asserts that better results in gastric cancer will only come when the internist acquires the diagnostic acumen to strongly suspect malignancy and possesses, in addition, the courage necessary to enable him to act on that suspicion before it becomes a certainty. Persistent digestive cases should be watched carefully for a few days or weeks only. If there is progressive but slow development of disordered function with pain or vomiting, impaired secretion, emaciation and especially tumor, the wisdom of prompt exploration should be frankly put before the patient.

Czerny's dictum that the presence of a tumor is too late for operation has been disproved by Korte's experience. Thirty-four out of 38 resections had a tumor. The absence of early obstruction is one reason why

symptoms are so illusive, and hence the advent of a tumor is a fortuitous circumstance that by its obstructive symptoms urgently compels diagnosis that should lead to early interference. Nordmann, out of 126 cases, found only one out of four where removal of the tumor was practicable. This is a sad diagnostic commentary.

If exploration proves the condition inoperable, the wound should be closed with buried non-absorbable sutures, and the patient gotten up and out of the hospital at the end of a week. If obstruction is serious, a quick gastro-enterostomy is relatively safe. Robson had only one death in 24 palliative operations. Relief from pain and vomiting is most grateful and life is often prolonged for many months and in a good many instances to a year or longer. The danger of an exploration is not *per se*, but in ill-advised and overzealous efforts to attempt interference in conditions that should be left severely alone.

A writer in the last six months quotes a mortality of 70 per cent. in operations for malignant disease with adhesions and 27 per cent. without adhesions. These figures are tremendously too high and do not represent the possibilities of the modern operation nor the results already obtained which have reduced the death rate from operation to 4 or 5 per cent.

The Mayos in 114 malignant cases had twenty-one deaths, or 18 per cent. There were 63 pylorotomies and partial gastrectomies, with eight deaths, or 13 per cent. The worst cases had only a gastro-enterostomy and the severity caused the high mortality. In the last 41 cases for malignant disease operated in the last twenty-two months the mortality was only 8 per cent.; 25 consecutive, with only one death, 4 per cent. As to ultimate results in 70 cases of resection, four lived more than five years, 9 were still living from one to five years, a number are well after two years, and a majority lived over one year. Of the 16 operated over three years ago, four are living, or 25 per cent.; one is alive and well after four years and ten months. Of Korte's 22 patients who survived the operation, 13 lived from one to five years, 9 were still living from one to five years. Kocher had 45 cases of partial resection since 1898, with mortality 17 per cent., as against 44 per cent. in 52 resections previous to 1898. The strictly operative mortality was really only 5 per cent.; 20 of the 97 were living, 10 having survived more than two years. Petersen, in 18 cases successfully undergoing resection more than three years ago, had 7 alive and 4 had lived twelve, eleven, five and four years, respectively.

The late lamented Mikulicz, who did more than any other contemporaneous European surgeon for the advancement of gastric surgery, obtained a permanent cure or immunity for over three years in 16 per cent., and sadly enough he at last fell a victim to the dread malady for whose alleviation he had done so much. He cheerfully assented to exploration at the hands of Eiselberg, and when it was found inoperable, he recovered and continued undauntedly at his work until the end. Than this there is no greater heroism.

A description of partial gastrectomy is as follows (Mayo):

Step 1. Open the abdomen.

Step 2. Double ligate and divide the gastric artery. Ligate and divide the necessary amount of gastro-hepatic omentum close to the liver, leaving most of its structure attached to the stomach. Double ligate and divide the superior pyloric artery and free the upper inch or more of the duodenum.

Step 3. With the fingers as a guide underneath the pylorus, in the lesser cavity of the peritoneum, ligate the right gastro-

epiploic or gastro-duodenal artery, and progressively tie and cut away the gastro-colic omentum distal to the glands and vessels up to the appropriate point on the greater curvature and here ligate the left gastro-epiploic vessels.

Step 4. Double clamp the duodenum, divide between with the cautery leaving one-fourth inch projection. With a running suture of catgut through the seared stump, the end of the duodenum is closed as the clamp is removed. A purse string suture about the duodenum enables the stump to be inverted. The proximal end of the stomach is double-clamped, along the Mikulicz-Hartmann line, divided with cautery, leaving one-quarter inch in projection.

Suture through the seared stump with a catgut buttonhole suture.

This is again turned in, after removal of the clamp by a continuous silk or Cushing suture.

Step 5. Independent gastro-jejunostomy.

Step 6. Closure of the wound.

Petersen says:

Resection is practiced more than it was because: (1) Resection is not more hazardous than gastro-enterostomy. Twice as many patients die from pneumonia after the latter than after the former operation. The removal of the decomposing cancerous tissue appears to be of great value. (2) The prospect of radical cure is much greater than was thought. The stomach and duodenum must be excised as widely as possible. (3) Even when recurrence takes place, resection prolongs life on an average about nine months, as opposed to the four to five months of its rival.

## SCIENCE AND ART IN MEDICINE.

THEIR INFLUENCE ON THE DEVELOPMENT OF MEDICAL THINKING.\*

JOHN C. HEMMETER, PH.D., M.D.

Professor of Physiology and Clinical Professor of Medicine, University of Maryland.

BALTIMORE.

### IS MEDICINE A SCIENCE OR AN ART?

Medical men the world over frequently have to hear the criticism, I might call it the reproach, that medicine is not a pure science, that its methods and its discipline are not sufficiently accurate to merit this term. On the other hand, critics are not wanting among the non-medical public, who argue that medicine is not a perfect art.

Now, what is an art, and what is a science? In a recent address President Ira Remsen<sup>1</sup> attempts to define these terms, and on the authorities there quoted by this versatile educator we might profitably start out by borrowing the interpretations of the terms science and art. One writer says: "The distinction between science and art is that science is a body of principles and deductions to explain the nature of some matter, and art is a body of precepts with practical skill for the completion of some work. Science teaches us to know, and art to do. In art, truth is a means to an end, in science it is the only end. Hence, the practical arts are not to be classed among the sciences." Another writer says: "Science and art may be said to be investigations of truth, but one, science, inquires for the sake of knowledge, the other, art, for the sake of production. Hence, science is more concerned with the higher truths, and art with the lower. Science is never engaged, as art is, in productive application."

These definitions are apparently not equally clear with regard to science and art. With regard to science, they are clearer than with regard to art. Science has

for its object the accumulation and systematization of knowledge, the discovery of truth. This part is clear, and also that art is a body of precepts with practical skill for the completion of some work. But it is not clear how truth is only a means to an end in art, and in science it is the only end. Surely, if a truth could be expressed as a precept in as concrete a form in any art as it could be in a pure science, it would be, or at any rate should be, the only end, the only object of the art as well as of the science.

Then the question might arise, What are higher and what are lower truths? In the decision much depends on the individual standpoint of the judge. What is a higher truth for a scientist may be a lower truth for an artist, and *vice versa*. If it is said that in art truth is a means to an end, we have a right to inquire what is meant by the truths of an art? For instance, are counterpoint, thorough base, and harmony the truths of music?

I know of but two individuals in the history of the modern scientific world who, by training and experience, could be considered competent to answer this question, both having been artists and scientists at the same time, of acknowledged ability. One was Hermann von Helmholtz, physicist, physiologist and musician. The other was Theodor von Billroth, anatomist, pathologist, surgeon and musician. Both of these men have given us the benefit of their thinking on the borderland between science and art. Helmholtz, in his "Sensations of Tone," and Billroth, in his "Psychologische Aphorismen über die Musik" (Wer ist Musikalisch). To the student of either of these works seeking information on the questions above propounded, it must soon become evident that an exact and definite distinction between art and science is not always possible; particularly it is not possible in any concrete case. We are, therefore, enabled to meet the critics arguing that medicine is not an exact science nor a perfect art, with the statement that a distinction between these two is by no means possible and that there is much debatable territory between human knowledge and human ability. Medicine did not originate as a science, but by dire force of necessity. For centuries on centuries its treasures were gathered from experience only, and were developed into an art by the genius of its representatives. Professor Remsen<sup>1</sup> was, perhaps, too accurate in attempting to draw a hard and fast line between art and science. Every science is desirous to become an art, and every art tends to become a science. So also medicine. I mean by this that art requires a scientific foundation and that science requires ability to do. In other words, science requires productive application, the power of achievement.

My convictions induce me to differ from my erudite teacher, Professor Remsen. At least, to differ with him in applying the same ideas to medical science as he is disposed to set up for the science of chemistry. In rating the history of the discovery of oxygen and chlorine by Scheele (1774), he lays great stress on what seems to him a fact, that Scheele did not work toward these discoveries with any practical object in view, and, though this work, while it was being done, seemed to be of no utilitarian promise, its value in the light of present-day industry can not be overestimated. It would be very difficult to prove that Scheele worked absolutely oblivious of any practical results that his work might have. It is true that scientific men frequently work from pure love of science, prompted by high ideals and disinterested enthusiasm, but there is often an under-

\* Address on occasion of conferring of the degree of doctor of laws (*honoris causa*), St. Johns College, Maryland.

1. "The Age of Science," Science, July 15, 1904.