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THE SURGEON AND THE RESEARCH LABORATORY *

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The advance of modern medicine and surgery is due to the casting off of the garments of preconceived hypotheses of bygone ages; a contempt for philosophic dogmas and a disregard for systems of practice not founded on the observations and elucidation of natural phenomena that are governed by definite and fixed laws. These laws have been revealed to us by scientific research, so that speculation by induction had to give way to a science based on objective observation. As our science broadened and became well founded, the art of surgery became highly developed, so much so that its operative possibilities appeared almost limitless. We must agree with David Starr Jordan when he says: "All art is based on science. Science is human experience tested and set in order. Art is knowledge in action. An art which is not based on knowledge becomes a mystery or trade. Sound medicine must rest on science."

While we have progressed in a marvelous degree during the last half-century, we cannot but feel that we still have much to do. We must confess that in many ways we have only begun. There remain so many questions on which we have no light, we therefore come together often to compare our views.

One of the purposes of this Section is to record our work, to exchange ideas and to study the collective experiences of this body. We interrupt our daily work in order that we may come together and review our labors, to thrash out problems, to retain the useful and to discard the impractical. We aim to strengthen the underlying surgical principles and to make our practical achievements more efficient.

When we consider the work of the various sections of this Association, we find that their work falls into two large and distinct groups. We find that to the first group belong the purely scientific and fundamental studies, namely, anatomy, physiology, chemistry, pathology and its coordinate divisions of histology and bacteriology. These are purely research and experimental and yet fundamental. To the second group belong the sections of the practice of medicine and surgery and its many subdivisions. I may say the divisions of applied science—the application of scientific principles to the practice and art of medicine and surgery. To the first division belong the men who devote themselves entirely to the unraveling of basic problems and the teaching of principles.

While modern medicine and surgery has its body of research men, whose labors have been entirely of a research and philosophic character, men whose labors have largely laid the foundations for the modern superstructure of the art of surgery, there is a large class of investigators who combine the art of their practice with laboratory research—men whose inspirations came to them during their daily labors in the operating-room and at the bedside, where practical observations are made that, sometimes, suggest certain theoretic solutions, the verification of which are found in experimental research; this developed the practical surgeon who solved his own problems in the laboratory. Then there are those surgeons whose daily labors are so burdensome and whose time is so completely taken up with practical work that the solution of many highly important questions is delegated to laboratory specialists. Besides there are those whose daily labors consume their energy and time to such an extent that no time is left for research work or even for thought. Their practical experiences, and often valuable observations, are lost to the profession. These men neither publish nor publicly discuss their methods. There are still others who fail to share the results of their experience not only because of lack of time, but either on account of lack of training in recording, classifying and analyzing their material, or because their interest in medicine and surgery is pecuniary rather than scientific. Often their profession is to them a bread-and-butter affair and not one of a progressive science.

Briefly, we have the specialist in research work, who devotes all his time to the laboratory; the practical surgeon, who verifies his conceptions in the laboratory; the busy surgeon, who delegates the solution of his surgical concepts to the research specialist; the surgeon who has neither time nor inclination to record or discuss his work, and the surgeon who is often a simple technician, who is not troubled by anatomy, pathology, etiology or diagnosis, whose whole stock in trade is rapidity of movement, and who glories in the large number of cases that pass through his hands.

We have another class, an ever-increasing class, which is preponderant in our section, whose contributions comprise a record of applied surgical science; of a critical analysis of certain surgical principles applied to definite pathologic findings at the operating-table; of a clear understanding of infections which has so broadened the field for surgical endeavor that many operators now group their special cases, affecting certain organs, by the dozen, hundreds, and in some instances by the thousands, that they may be enabled to make their deductions with precision. Some of these operators are associated with pathologists of the highest order, men who study a living pathology both at the operating table and in an adjoining laboratory. The immediate investigation of living tissue has become a common practice,

* Chairman's Address before the Section on Surgery of the American Medical Association at the Sixty-Fourth Annual Session, held at Minneapolis, June, 1913.

making operative methods more precise, and the limitations of surgical possibilities better understood.

Surgery, then, has become more and more an exact science and its practice a highly specialized art. It became more an exact science because, like every other science, it was built up by the accumulation of unquestioned facts from contributions the world over. Philosophic deductions and preconceived theories and hypotheses into which facts were made to fit could not stand the test of a progressive science.

Still, we are not unmindful of the fact that the human machine involves many unsolved complex problems in the biology of a living organism. The mechanic has before him a less difficult task in the construction of a machine, and yet even he finds idiosyncrasies in many of his mechanisms that are built after the same model. He sometimes searches long before he locates and corrects a defect.

The surgeon, working under modern methods, can state in percentages the chances for restoration of function and the preservation of life in a large majority of surgical cases. But there remain many conditions in which the outcome is uncertain and in which the factors of safety are not fully understood. It is for the solution of these undetermined questions that the research laboratory is indispensable and the highly trained research specialist a necessity.

While the surgeon is thoroughly familiar with many factors that may operate for and against a favorable outcome, there still remain many unknown factors, in a large proportion of cases, that are difficult to estimate in given cases, and which affect the operative possibilities—factors that are not apparent at the time; consequently the operator often deals with unknown conditions, so that he cannot accurately estimate whether the task can be successfully accomplished or not. There remains to be worked out, therefore, many problems, biologic in character, that can be done only by highly trained laboratory workers, who must closely cooperate with the practical surgeon. The laboratory data, to be of practical value, must agree with the findings on the operating-table. The surgeon makes his observations on the living subject; the laboratory must elucidate and make them clear. The solution must be scientific. The methods of past ages have been speculative, which created, by induction, a philosophy that was often based on a very slender foundation of facts; facts that were often made to fit the philosophy. Our modern methods begin in the opposite direction, they consist of observation of natural phenomena. Preconceived ideas must give way to objective observations.

Much is required of the modern surgeon in the clear analysis of biologic detail. Therefore we must approach our problems in a scientific spirit. In order to do this we should be scientific investigators of the highest training. There should be a thorough knowledge of laboratory technic in all its details.

It becomes evident at once that this is not always possible. Surgeons who possess the highest and best skill, whose operative technic is beyond criticism, whose pathologic and diagnostic attainments are of the highest order, often men who have been pathfinders, can devote little or no time to laboratory research. Their time is completely absorbed with operative and hospital work and other professional duties. Their practical contributions have been of the highest value. Their theoretical deductions may have been right or wrong; only the research laboratory, in many instances, can determine the truth.

It may be said that all surgeons should command a thorough laboratory skill and the younger generation does. The leading medical schools insist that each student must have a thorough laboratory training that inculcates the scientific habit of thought and practice. He is encouraged to investigate unknown fields. To collect and correlate and analyze biologic, pathologic and technical data. He begins his professional career well trained, but, in many instances, the routine of daily duties absorbs his time, and the fatigue incident thereto unfits him for the laboratory. Perhaps his practical achievements absorb his enthusiasm. Possibly the laboratory never aroused a desire for that kind of work. Whatever the cause may be, we very soon find that the rank and file of the highly trained students cannot, or will not, devote any considerable time to research work. There remains, of the vast army of modern graduates, a small company of men who are imbued with the real scientific spirit—men whose love of the truth leads them where it may, outweighs all else. We are fortunate in that we have a growing class of such men. They often occupy positions in some of our large, well-equipped, highly organized and well-endowed hospitals.

They are often found in institutions that are controlled by or affiliated with medical schools, institutions in which there is a happy combination of hospital observation, of research work and teaching. Such an organization is capable of great good for progress. Then there is the isolated investigator whose ardor is not at all affected by his isolation. He works in solitude and alone and sometimes achieves epoch-making results. Take it all in all, the surgical profession may be divided into two groups: first, a small group, to whom we must look for progress and scientific advancement; and second, a group that composes the majority of surgeons who do the routine work of daily practice. Many of these are men of keen observation, who develop methods of practice based on clear ideas of living pathology found at the operating-table. It is true that many of our great discoveries and often epoch-making advances have been made by the practical surgeon; so thus the names of many men have become synonyms for certain procedures. Among Americans there are Ephraim McDowell and the beginning of abdominal surgery; Marion Sims and the repair of vesicovaginal fistula; Crawford Long and W. T. G. Morton and others and the discovery of anesthesia (1846); Fitz of Boston and the pathology of appendicitis (1886); Valentine Mott and the ligation of large arteries for the cure of aneurysms; Philip Syng Physick and the use of buried animal ligature and the manipulation in the reduction of dislocations; Bigelow of Boston and the reduction of hip-joint dislocation and litholapaxy.

Among the pioneer surgeons of this country who originated procedures may be mentioned John Warren, who in 1804 first excised the parotid gland; Dr. Dixi Crosby of Hanover, New Hampshire, who did the first interscapulothoracic amputation for the removal of the upper extremity in 1836; Wolcott of Milwaukee, who performed the first nephrectomy and Bobbs of Indianapolis, who did the first cholecystotomy. Russell of Oshkosh is credited with the first suprapubic hysterectomy for uterine fibroid. Willard Parker, in 1867, reported a number of cases of suppurative typhlitis and saved 75 per cent. of the patients. Joseph K. Swift of Easton, Penn., and Gordon Buck of New York are credited with the first use of extension and counterextension for the treatment of fracture of the femur. John Warren of Boston was the first to do cardiocentesis. John Pau-

coast did the first successful operation for extrophy of the bladder. Detmold of New York, 1849, first evacuated a brain abscess. These names comprise a few of the practical American surgeons whose skill and rare insight have established new procedures.

Here we have a host of practical men who evolved methods of practice and whose only opportunity was found in the operating-room. They had no laboratories, were not trained in research work, but they understood the problems as they presented themselves and they mastered them. They were unmindful of tradition. They created means that succeeded. They were pathfinders. The paths were opened and it became the duty of those who followed to elaborate and elucidate the unnumbered obstacles that were encountered and to solve the problems which, as surgery advanced, became more complex and more difficult of solution. The unraveling of minute changes in the grosser lesions required more refined methods of investigation. The surgeon soon found that he must have a special training or that he must have the assistance of specially trained associates. He then turned for cooperation to the laboratory specialist, whose services he found invaluable, in fact indispensable.

The laboratory worker entered into close association with the surgeon. The investigator frequently stood beside the operating surgeon and observed the living pathologic structure as it was exposed. He obtained a history antedating the removal of the diseased tissues, and he followed the later progress of the case in order to fully appreciate a pathology from its beginning to its end. He began to investigate living structures. We had too long drawn our conclusions from the findings of post-mortem material, which represented only the end results. The study of living pathology is rapidly becoming the practice. Therefore, in order that we may appreciate to the fullest extent the early tissue-changes, the investigator must cooperate closely with the operating surgeon in order that he may solve the problems for which he is especially trained. While he is working with the surgeon, he need not be deterred from the investigation of problems of his own choosing.

The one danger of the investigator, working entirely by himself, is that he may become too theoretic; therefore the benefit of more or less close association with the operating surgeon. Experience has shown that cooperation in scientific work achieves the best practical results. The practical worker needs the assistance of the theoretic departments. Science is continuously progressive. No one branch of it can stand by itself; there must be cooperation, correlation of the one with the others. In the solution of the problem the investigator should have his own way and his own methods. The surgeon may present the problem and, in a general way, indicate the methods to be followed, but he must refrain from dictation, especially as to details. Frequent criticisms on his part would be confusing to the investigator and might be detrimental to the necessary enthusiasm. The investigation may be long, it may not lead to immediate results—in fact, it may apparently lead away from the subject; there may be an accumulation of theoretic data that may appear unimportant, but a persistence, keeping ever in mind the original problems, will lead to a solution. In the course of an investigation other problems may be unraveled.

To secure training and development the research specialist must serve an apprenticeship in the laboratory. The first aim of the laboratory should be to teach the student to observe, to see, to think, to comprehend.

This is the chief aim of all objective teaching which begins with the fundamentals. When these have been mastered, the work must begin in well-equipped laboratories presided over by highly trained investigators and teachers.

The clinical and laboratory instruction must continue side by side and there should be a constant agreement between the two. Should any discrepancy arise, we should cling to the clinical findings rather than to those of the laboratory, for the sake of the sufferer, until the time arrives when there is absolute harmony between bed-side findings and the laboratory. Every student should be trained in all the essentials pertaining to clinical as well as laboratory technic. The laboratory worker who ignores bed-side findings does not fulfil his mission. Among the many duties of the instructors, an important one is to take note of such pupils as excel in laboratory work, men who possess powers of accurate observation, and give them special attention and encouragement, and to select and segregate those who are particularly qualified. The qualifications for research work are: first, keenness of observation, which means unlimited repetition until the results are established, and, second, an ability to correctly interpret facts and a recognition of their relationships. "Now, it is evident that you cannot make a sound conclusion without the facts, and these are gained by observation with and without experiment. It is equally evident that an isolated fact is barren and dead. Facts are like cells of a complex animal, all interrelated, mutually affecting and affected."¹

The student cannot become well qualified except under expert instructors; men who are, first of all, professional anatomists, physiologists, biologists and who are expert in every branch of technic pertaining to these subjects. They must have had a large experience in research work before they become instructors. The student, by the acquirement of technical skill as well as training in learning to see, to weigh evidence and apply principles to his practice, not only becomes qualified for research work but it would seem that he is better prepared to do every-day practical surgical work, if he should choose to become a surgeon. I am of the opinion that the laboratory of the medical school should have in view not only the acquirement of routine knowledge of the various subjects, but the training should have the aim of training men both for the purpose of research work and for becoming proficient in operative technic; to better prepare them for the practical duties of their profession. The first consideration in the organization of the medical school has become the selection of men. Instructors are more important than equipment. No equipment can be adequate for a purpose until we have the man who plans and selects and knows how to utilize it to the best advantage. On the other hand, no matter how good the man is, he must have at hand all material for his purpose and he must have a place in which to work. To be of the greatest assistance to the surgeon, he must have a well-equipped laboratory and library and he must be so situated that he works in close intimacy with a surgeon in a well-equipped surgical hospital. He should be able to secure his pathologic material immediately after its removal from the body, so that he may investigate fresh tissues and not be dependent altogether on embalmed material. The surgeon must give every possible assistance and deliver his material in such a condition as to

1. Lyon, E. P.: Equipment and Instruction of the Laboratory Years, *THE JOURNAL A. M. A.*, May 27, 1911, 1539.

be most available to the pathologist for instruction and investigation.

The research laboratory should combine the features of all the other special laboratories. There should be an equipment for anatomic, physiologic, chemical, microscopic and biologic experiments. In a modern medical school in which these five special laboratories are situated in close proximity to the hospital, special research work may be conducted in one or all of them and the work may be carried from one to the other as may be necessary. As a matter of convenience, however, the work may be expedited best in a laboratory where the necessary special apparatus can be brought together.

In addition to the aforesaid special laboratories may be added a well-equipped surgical operating room where operations may be done on animals as taught in the Hunterian Laboratory of Experimental Medicine at Baltimore and the Institute for Experimental Medicine in St. Petersburg and many other institutions in this country and abroad. The principles of surgery should be taught, not special operations. The chief criticism against such surgical instruction has been that abdominal surgery has received the main attention, and that the pupils having had an operative course have been inclined to begin their practical activity with abdominal surgery.

To have all of this equipment is desirable and adds much to the convenience of the experimenter. But it must not be the first essential. The laboratory director is more important than buildings. A resourceful investigator outweighs fine apparatus. A skilled research-worker can, to a large degree, construct his own apparatus. In selecting a school, the student should ascertain whether or not it is well manned before he takes into account architecture and apparatus. As to being well manned, I mean manned with men who are patient, proficient, progressive; men who are not satisfied merely to investigate and verify what others have done, but who must advance, develop and create. Whether research worker or surgeon, or both combined in one, he must have time enough to teach and instruct the student. I have no patience with the laboratory investigator who says that he abhors the routine of teaching. No man is better qualified to teach than the one who has worked out the problem.

We must agree with Welch² when he says:

A tendency at the present time to separate scientific research from the work of teaching has certain advantages, but has, I believe, even greater dangers. Scientific investigation in medicine, during the last two decades, has led to results of such vast importance as regards our power over disease that it makes an appeal to the public and to philanthropists much stronger than does medical education. Hence it is that large funds are available for institutions of research and for research hospitals which have no connection with education. Hospitals are often more eager to contribute to scientific medicine than to participate in the work of medical education and in a number of instances have been provided with funds and laboratories intended solely for scientific research. While there is room for such independent endowments and institutions, the roots of fruitful scientific work lie in the educational system, and if the latter is neglected the former will suffer. The traditional home and the most favorable environment for productive research is the university, and hospitals in affiliation with universities offer, I believe, the best opportunities for the promotion of medical science and art. Above all, the teacher should be an investigator.

If it is impossible to combine in one plant all the aforesaid special laboratories and one only can be had, then it must be admitted that the research laboratory should be in close proximity to the physiologic laboratory with trained men. Physiology is the foundation on which clinical and research work must rest; it is the beginning. Clinical work, whether medical or surgical, can have no practical results unless founded on physiology. Therefore we must have a clinical physiology (Yandell Henderson).

The labors of Brown-Séquard, Claude Bernard, Ludwig, Fritch and Hitzig were fundamentally physiologic and necessary to the elucidation of clinical conditions. Bernard's discovery of glycogen, a physiologic study, led to an understanding of diabetes. His discovery of vasomotor nerves illuminated the problem of animal heat and fevers.

Clinicians have sometimes been slow to adopt and apply to practical use methods and means of common practice in the physiologic laboratory. An example is the measurement of blood-pressure in millimeters of mercury which had been done by physiologists fifty years before it found its way to the clinician (Yandell Henderson).

Only in very recent years has the surgeon availed himself of the value of the sphygmograph. The physiologist had already accumulated an immense fund of data.

Sauerbruch and Brauer made use of what was long since common knowledge of the physiologist—knowledge that enabled them to gain access to the interior of the thorax. The work of Crile on the subject of shock was an elaboration of the physiology of the vascular and nervous system. Cushing's splendid work on the pituitary body was a physiologic and anatomic study. In this same category belonged Erlanger's work on heart-block and Cannon's studies on normal movements of the stomach and intestines, and Meltzer on intratracheal insufflation. All of Carrell's work and that of Matas and Crile on blood-vessel surgery has been physiologic. When Senn, Murphy, Halstead and Connell taught us their methods of intestinal suturing, we found it to be based on physiology.

Since all of our therapeutic endeavors are directed toward an attempt at a restoration of a disturbed or perverted function to a normal or physiologic condition, all of our experimental work must be fundamentally physiologic; and, finally, when we endeavor to use all of this work in a practical way, that is, to clinical ends, we have a clinical physiology. The more we know of physiology the more we know of clinical conditions.

The hospital laboratory should primarily cooperate with the staff in the unraveling of the nature of the diseases afflicting the inmates; in other words, in assisting and determining a diagnosis. Its other function, which may be far more important, consists in the study of undetermined problems. The laboratory staff should be so divided that one or more members should confine their time to the routine diagnostic work, which should have its own equipment and a separate laboratory. The research work should be entirely separated and have its own department. Its staff should have absolute freedom for its own work and in the working out of surgical problems. The surgeon should be consulted so that he may cooperate and aid in the studies. The surgeon is confronted, daily, by unsolved conditions; so he may suggest the kind of work to be done, and may indicate the object to be achieved. In this way the efforts of the research worker and surgeon will lead to definite ends. Crile, when he observed the disastrous effects of shock,

2. Welch, William. *The Hospital in Relation to Medical Science*, THE JOURNAL A. M. A., Nov. 19, 1912, p. 1607.

both traumatic and emotional, drew his own conclusions as to the underlying cause. He called to his aid his laboratory collaborators and together they determined the cell-changes in the brain.

Aside from the numberless questions pertaining to the determination of limits of safety in surgical procedures that must be worked out, such as the questions in relation to immunity and to the immense field of serology, the margin of which has only been touched, vast unknown possibilities are in store for us. The science of pathologic tissues and bacteriology are succeeded by a biochemical era. Much work has been done and an immense literature has accumulated and a vast army of earnest men have established innumerable facts in immunology and serology. Many principles have been established and yet many methods of practical application are still involved in much uncertainty; but the future will be full of revelations.

The unsolved question of the etiology of neoplasms offers an unlimited field for work. Is cancer due to a micro-organism or a perverted metabolism? Cancer seems to be increasing and why? While questions such as these are yet unanswered, an immense amount of information has accumulated. Much positive knowledge regarding its history, distribution and development; much that is more than suggestive as to its cause, and much negative evidence as to what does not cause cancer is at hand. Cancer research has been carried on with commendable activity since 1901 and 1902, when Loeb in America and Jansen in Denmark succeeded in transplanting cancer in rats and mice.

We have learned that cancer-cells may apparently grow indefinitely by transplantation through many generations. We have seen that cancer retrogresses under certain conditions; that there is such a condition as immunity to cancer; that cancer may, at times, gain in virulence. Experimental research seems to point to the cancer-cell as the real parasite rather than to a specific and distinct micro-organism. Family histories seem to point to heredity, but experimental research has taught us nothing. Mice have apparently been cured of cancer by serum therapy; what this may lead to in its application to man, is still uncertain. Coley seems to have established the principle of the cure of sarcoma by the use of serum of streptococcus and *Bacillus prodigiosus* in 10 per cent. of cases. Why the serum fails in 90 per cent. is a question for future determination. Ehrlich thinks that the beginning of the end of the cancer problem is in sight. I am sure that our optimism in relation to the eventual discovery of a cure by experimental research is well founded.

Much more might be detailed as to the great work on which the investigator has only begun. The possibilities are limitless. The work ahead is arduous and difficult. The rewards will be rich. The future of surgery and medicine will occupy a higher plane than any of which the optimist now dreams. For the present, the surgeon recognizes the necessity of the closest cooperation with the laboratory specialist. The one needs the other; both must work side by side.

106 South Thirty-First Avenue.

Need of Good Pre-Medical Education Recognized Thirteen Hundred Years ago.—"For a medical man should know the ars rhetorica, that he may be able to support with sound arguments the matters which he deals with; and also the ars dialectica, so that by the exercise of reason he may investigate the causes of sickness for the purposes of cure."—Isidorus Hispalensis, Bishop of Seville, 600 A. D.

YESTERDAY, TO-DAY AND TO-MORROW

THE ACTIVITIES OF THE COUNCIL ON PHARMACY AND CHEMISTRY *

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It seems but yesterday, though it was eight years last February, that the Council on Pharmacy and Chemistry was founded by this Association, with the hope of correcting, as far as possible, the evils which were current in the field of materia medica. The story of this Council has been told repeatedly; but it seems to me worth telling again, partly because it may be new to some of the younger members at least; partly because it contains some facts and lessons which can scarcely be repeated too often; and partly because the present activities of the Council can be appreciated, and therefore can be valuable to the medical profession, only in the light of its history.

THE EXPLOITATION OF PROPRIETARY REMEDIES

The extraordinary profits derived from the sale of exclusive pharmaceutical specialties had flooded the market with such preparations. As the natural result of unrestrained competition, these were being exploited with ever increasingly extravagant claims. The relatively recent discovery of the therapeutic possibilities of the synthetic chemicals, which were patented and therefore proprietary, was used to give a pretense of scientific respectability to all kinds of uncritical statements; and under this cloak of pretended respectability the most unscientific nostrums were not slow to seek shelter. Even men of scientific training found it difficult, if not impossible, to sort this confused material by their individual efforts, and were therefore obliged to treat it more or less uncritically, and thus, directly or indirectly, wittingly or unwittingly, lend the weight of their authority to this exploitation. Much more helpless was the general practitioner. Without the training, the time or the material for discriminating study, assailed from all sides by the din of the detail man, by the laudatory "literature" of the advertising pages, the reading-matter, and even the editorial comments of respectable medical journals, he was a helpless and easy victim for the skillful proprietor.

Not content with this form of exploitation, many manufacturers used their success with the profession to introduce their remedies directly to the public under a different name, or even under the same name, with claims still more extravagant, if that were possible, and backed now by the authority of professional endorsement.

In any case, the consumer, as usual, "paid the freight," not only by paying extravagant prices for useless drugs, but even more seriously, because the uncritical habits thus engendered made for careless practice in every other respect. It may well be questioned whether the discovery of the synthetic drugs did not at that time work vastly more harm than good to the public. Their ultimate effect, of course, like that of every scientific discovery, must be useful; indeed, we are now reaping some of the genuine benefits. Then, however, the good was offset by the evils which they encouraged.

* Read in the Section on Pharmacology and Therapeutics of the American Medical Association, at the Sixty-Fourth Annual Session, held at Minneapolis, June, 1913.