Hence equating coefficients of the powers of *n—* ∫∫*p*(1/R *+* 1/R')*d*S *=* 2∫∫*d*S*, and* ∫∫2*pd*S/RR' = ∫∫(1/R + 1/R')*d*S.

References to the original memoirs will be found in Salmon's *Analytical Geometry of Three Dimensions,* Frost’s *Solid Geometry* and, more completely, in Darboux's *Leçons sur la théorie générale des surfaces.* J. Pu.; F. Pu.)

**SURGE,** in meteorology, an irregular fluctuation of the barometer, extending over a long period *(e.g.* a month), in contradistinction to the shorter fluctuations, covering two or three days, caused by alternating conditions of high and low pressure. The cause of surges is not understood.

**SURGERY** (Fr. *chirurgie,* from Gr. χ*ειρoυργια*, *i.e.* hand-work), the profession and art of the surgeon *(chirurgien),* connected specially with the cure of diseases or injuries by operative manual and instrumental treatment.

*History.—*Surgery in all countries is as old as human needs. A certain skill in the stanching of blood, the extraction of arrows, the binding up of wounds, the supporting of broken limbs by splints, and the like, together with an instinctive reliance on the healing power of the tissues, has been common to men everywhere. In both branches of the Indo-European stock surgical practice (as well as medical) reached a high degree of perfection at a very early period. It is a matter of controversy whether the Greeks got their medicine (or any of it) from the Hindus (through the medium of the Egyptian priesthood), or whether the Hindus owed that high degree of medical and surgical knowledge and skill which is reflected in Charaka (1st century a.d.) and Susruta (2nd century) (commentators of uncertain date on the Yajur-Vcda) to their contact with Western civiliza­tion after the campaigns of Alexander. The evidence in favour of the former view is ably stated by Wise in the Introduction to his *History of Medicine Among the Asiatics* (London, 1868). The correspondence between the *Susrula* and the *Hippocratic Collection* is closest in the sections relating to the ethics of medical practice; the description, also, of lithotomy in the former agrees almost exactly with the account of the Alexandrian practice as given by Celsus. But there are certainly some dexterous operations described in Susruta (such as the rhinoplastic) which were of native invention; the elaborate and lofty ethical code appears to be of pure Brahmanical origin; and the copious materia medica (which included arsenic, mercury, zinc, and many other substances of permanent value) docs not contain a single article of foreign source. There is evidence also (in Arrian, Strabo and other writers) that the East enjoyed a proverbial reputation for medical and surgical wisdom at the time of Alexander’s invasion. We may give the first place, then, to the Eastern branch of the Indo-European stock in a sketch of the rise of surgery, leaving as insoluble the question of the date of the Sanskrit compendiums or compilations which pass under the names of two representative persons, Charaka and Susruta (the dates assigned to these ranging as widely as 500 years on each side of the Christian era).

The *Susruta* speaks throughout of a single class of practitioners who undertook both surgical and medical cases. Nor were there any fixed degrees or orders of skill within the profession; even lithotomy, which at Alexandria was assigned to specialists, was to be undertaken by any one, the leave of the raja having been first obtained. The only distinction recognized between medicine and surgery was in the inferior order of barbers, nail-trimmers, ear-borers, tooth-drawers and phlebotomists, who were outside the Brahmanical caste.

Susruta describes more than one hundred surgical instruments, made of steel. They should have good handles and firm joints, be well polished, and sharp enough to divide a hair; they should be perfectly clean, and kept in flannel in a wooden box. They included various shapes of scalpels, bistouries, lancets, scarifiers, saws, bone-nippers, scissors, trocars and needles. There were also blunt hooks, loops, probes (including a caustic-holder), directors, sounds, scoops and forceps (for polypi, &c.), as well as catheters, syringes, a rectal speculum and bougies. There were fourteen varieties of bandage. The favourite form of splint was made of thin slips of bamboo bound together with string and cut to the length required. Wise says that he had frequently used “ this admirable splint,” particularly for fractures of the thigh, humerus, radius and ulna, and it was subse­quently adopted in the English army under the name of the “ patent rattan-cane splint.”

Fractures were diagnosed, among other signs, by crepitus. Dis­locations were elaborately classified, and the differential diagnosis given; the treatment was by traction and countertraction, circum­duction and other dexterous manipulation. Wounds were divided into incised, punctured, lacerated, contused, &c. Cuts of the head and face were sewed. Skill in extracting foreign bodies was carried to a great height, the magnet being used for iron particles under certain specified circumstances. Inflammations were treated by the usual antiphlogistic regimen and appliances; venesection was practised at several other points besides the bend of the elbow; leeches were more often resorted to than the lancet; cupping also was in general use. Poulticing, fomenting and the like were done as at present. Amputation was done now and then, notwithstanding the want of a good control over the haemorrhage; boiling oil was applied to the stump, with pressure by means of a cup-formed bandage, pitch being sometimes added. Tumours and enlarged lymphatic glands were cut out, and an arsenical salve applied to the raw surfaces to prevent recurrence. Abdominal dropsy and hydro­cele were treated by tapping with a trocar; and varieties of hernia were understood, omental hernia being removed by operation on the scrotum. Aneurisms were known, but not treated ; the use of the ligature on the continuity of an artery, as well as on the cut end of it in a flap, is the one thing that a modern surgeon will miss somewhat noticeably in the ancient surgery of the Hindus; and the reason of their backwardness in that matter was doubtless their want of familiarity with the course of the arteries and with the arterial circu­lation. Besides the operation already mentioned, the abdomen was opened by a short incision below the umbilicus slightly to the left of the middle line for the purpose of removing intestinal concretions or other obstruction (laparotomy). Only a small segment of the bowel was exposed at one time; the concretion when found was removed, the intestine stitched together again, anointed with ghee and honey, and returned into the cavity. Lithotomy was practised, without the staff. There was a plastic operation for the restoration of the nose, the skin being taken from the cheek adjoining, and the vascularity kept up by a bridge of tissue. The ophthalmic surgery included extraction of cataract. Obstetric operations were various, including caesarean section and crushing the foetus.

The medication and constitutional treatment in surgical cases were in keeping with the general care and elaborateness of their practice, and with the copiousness of their materia medica. Oint­ments and other external applications had usually a basis of ghee (or clarified butter), and contained, among other things, such metals as arsenic, zinc, copper, mercury and sulphate of iron. For every emergency and every known form of disease there were elaborate and minute directions in the sâstras, which were taught by the physician-priests to the young aspirants. Book learning was considered of no use without experience and manual skill in opera­tions; the different surgical operations were shown to the student upon wax spread on a board, on gourds, cucumbers and other soft fruits; tapping and puncturing were practised on a leathern bag filled with water or soft mud; scarifications and bleeding on the fresh hides of animals from which the hair had been removed; puncturing and lancing upon the hollow stalks of water-lilies or the vessels of dead animals; bandaging was practised on flexible models of the human body; sutures on leather and cloth; the plastic operations on dead animals; and the application of caustics and cauteries on living animals. A knowledge of anatomy was held to be necessary, but it does not appear that it was systematically acquired by dissec­tion. Superstitions and theurgic ideas were diligently kept up so as to impress the vulgar. the whole body of teaching, itself the slow growth of much close observation and profound thinking during the vigorous period of Indo-Aryan progress, was given out in later times as a revelation from (heaven, and as resting upon an absolute authority. Pathological principles were not wanting, but they were derived from a purely arbitrary or conventional physiology (wind, bile and phlegm); and the whole elaborate fabric of rules and direc­tions, great though its utility must have been for many generations, was without the quickening power of reason and freedom, and became inevitably stiff and decrepit.

The Chinese appear to have been far behind the Hindus in their knowledge of medicine and surgery, notwithstanding that China profited at the same time as Tibet bythe missionary propagation of Buddhism. Surgery in particular had hardly developed among them beyond the merest rudiments, owing to their religious respect for dead bodies and their unwillingness to draw blood or otherwise interfere with the living structure. Their anatomy and physio­logy have been from the earliest times unusually fanciful, and their surgical practice has consisted almost entirely of external applications. Tumours and boils were treated by scarifications