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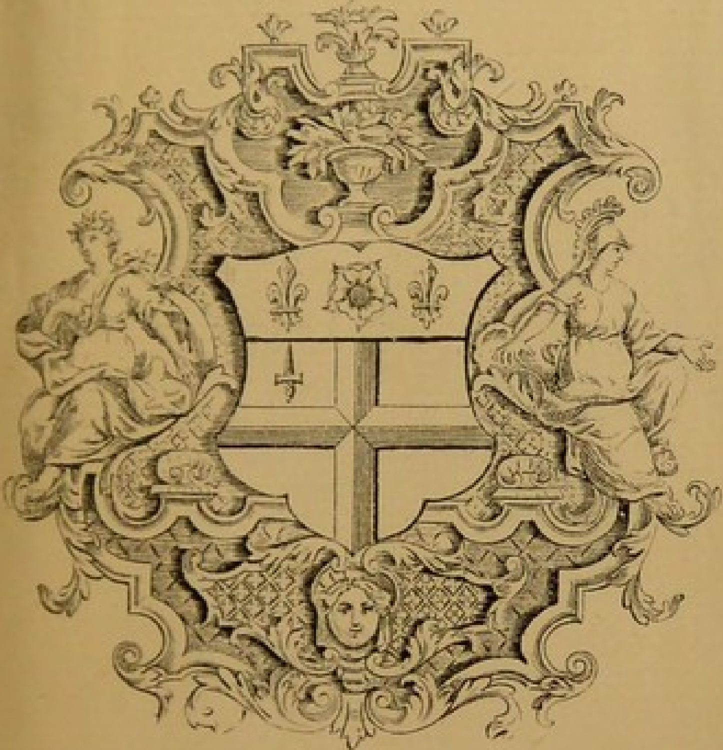

John Simon Esq. F.R.S.
With the kind regards
of the author.

A TREATISE

ON

GALL-STONES.

A

TREATISE

ON

GALL-STONES:

THEIR

CHEMISTRY, PATHOLOGY, AND TREATMENT.

BY

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ILLUSTRATED WITH PLATES.

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PREFACE.

If my own experience and reflection had not sufficiently impressed me with the sense of the intrinsic importance of the subject of this treatise, I should have derived it from the contemplation of the many eminent names which are inseparably connected with the history of its literature. When to the strong inducement thus afforded for its prosecution was added the knowledge of the circumstance, that there had not been published a monograph upon it in the English language for upwards of a century, I conceived the hope that a work of that kind might be neither unseasonable nor unwelcome. The main doubts which opposed this hope in my mind had reference to the nature of the elaboration which I should be in a position to give to the matter, so as to ensure novelty and completeness while excluding bulk and diffusion. I have endeavoured to meet these doubts by a conscientious performance.

During my literary inquiries I found that most systematic writers were so incorrect in their statements and references, and, nót rarely, so unintelligible in their accounts, that it became an essential part of my work to read or consult as many original authors as were accessible to me. The results of these labours have been corrections of numerous mis-statements propagated by compilers, as I could observe in some instances, from one to the other through the long space of two centuries. The necessity of these rectifications, together with the positive results of this search in books, appeared to me to afford some justification of the length of my first chapter.

Bearing in mind that Morgagni had almost exhausted the subject of the physical description of gall-stones, I endeavoured to be as short and dogmatic upon that part as the necessity of introducing some new matter on the nature of the nuclei of some calculi permitted. The casts of the biliary ducts which I found in the centre of gall-stones, were represented on two original plates, and their appreciation, by the aid of a fair description and a short discussion, was left to the judgment of the benevolent reader.

I then began that part of my work, by which I expected to furnish for my time on the field of chemistry what Morgagni had accomplished for his on the field of physical description; namely, a complete account of the analysis, ingredients, and composition of all varieties of gall-stones of man and animals, together, if possible, with an analysis and explanation of the morbid process to which they owe their origin. This led of course to some new intelligence on various collateral matters, among them perhaps the most interesting being the elucidation of the chemical nature of the colouring matter of bile. More important results were embodied in a new classification of gall-stones, which was immediately used for arranging all analyses of single gall-stones to be met with in the books consulted or expressly executed by myself. To the adoption of this arrangement I was moved not only by the contemplation of the requirement of completeness, but also by a wish to assist the probable wants of future inquirers, and to afford to curators of Museums facilities for the practical arrangement of their collections. The somewhat lengthy analyses of a number of ox gall-stones which were submitted to the scrutiny of the Chemical Society, led me to an attempt to explain the origin and nature of gall-stones by the light of the process of the putrefaction of bile; of which also I offered new analyses and an explanatory diagram. Thus I came upon a theory in the true sense of the word; namely, the explanation of the process as derived from all the data on the record, with so much only of hypothesis as seemed justified by the amount of incontrovertible knowledge.

The anatomy of gall-stone disease could be described with the aid of such a choice of materials, that the attainment of a fair abstract of the acquisitions of science was fairly to be demanded. To this I added the results of several dissections made by myself, together with the large amount of interesting information obtained by a careful contemplation of the specimens preserved in Museums, particularly in the one which derives from Hunter; illustrating not only the characters of calculi, but also their relations to and effects upon the biliary cyst and passages. The histories of cases in the catalogue of this latter collection appeared so instructive and so quaintly original, that I transferred to my text some of them which illustrated peculiar points in the pathology of the disease.

In the description of the symptoms of that episode of the disease generally termed hepatic colic I have been careful to avoid a common fault of authors, which consists in conjecturing a set or series of symptoms as the necessary consequences of particular anatomical conditions, of which the actual vital effects were not directly known by observation. In the description of the symptoms of the passage of gall-stones I have for the same reason exclusively relied upon cases in which the gall-stones were actually obtained and scrutinised by competent persons after the issue of the disorder. By this rigorous process many illusions propagated by compilers have been dispelled, and diagnosis, I hope, has been made much more certain and easy.

The rules for the treatment of gall-stone disease which I have given, although in their active or positive part they do not greatly differ from those observed hitherto, are decidedly negative in relation to certain energetic measures which up to the present time have been deemed applicable and useful in this disorder. While only a small number of these rules emanated from my own experience, all have in their turn been confirmed by it in cases which I attended either alone or in consultation. The treatment of biliousness—the disease which produces the casts of the bile-ducts and results in gall-stone disease, not the chimera which serves as the scape-goat of minds which are susceptible of satisfaction by a name without meaning—remains an open question until its symptoms are better ascertained and distinguished.

The collection of illustrative cases given at the end of the treatise every reader will be able to enrich for himself from his own experience. The portrait of the mind of the Medical Society of London, as it exhibited itself in the age the representatives of which are now gradually passing away, was added as a standard of comparison for later enunciations or discussions to come.

As the literature of France had been examined with such great care by Fauconneau-Dufresne, I believed myself justified in relying upon his treatise for that part of my materials which was not easily accessible to me. What he had failed to supply from German sources I endeavoured to furnish directly, and to record in substance or by reference. Special regard I paid to the literature of this country, and I believe that I have embodied accounts or notices of all the more important original observations contained in special treatises or periodical publications.

But for the kindness of friends who from time to time assisted me by the contribution of specimens many valuable points could not have been ascertained. Pre-eminent among these generous contributors stands Mr. Silas Palmer of Newbury, who, in aid of the furtherance of researches of which he had read some accounts in the 'British Medical Journal,' transmitted to me, then a stranger to him, a box full of the most valuable calculi—the result of the assiduity and attention which he had been enabled to pay to *post-mortem* examinations during the earlier years of his career. To Mr. T. Holmes I am indebted for the important specimens which contained the casts of the biliary ducts. Dr. Wilks kindly collected for me much human bile; and to the pepper-corn calculi sent by him to me the manes of Richard Powell are indebted for a restitution of rights of originality and competence which before had been denied to them.

My friend, Dr. B. W. Richardson, contributed the liver of a patient who had died during the transit of calculi through the biliary ducts. Most particularly am I indebted and thankful to the librarian of the College of Surgeons, Mr. Chatto, who by his kind assistance made agreeable the sometimes irksome task of searching books of all ages, sizes, and conditions.

J. L. W. THUDICHUM.

JANUARY, 1863.

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HUMAN BILE-DUCTS,
FROM CENTRE OF GALLSTONES.
X.120.

m the Microscope. M & N. Hanhart.

A TREATISE ON GALL-STONES,

&c. &c.

CHAPTER I.

DIGEST OF HISTORICAL LITERATURE.

THE earliest notice of concretions in the liver, which, with certain reservations, may be explained as gall-stones, occurs in the work of a Greek physician of the name of Alexander, who, from his birthplace, Tralle, a state in Lydia, received the surname of Trallianus. He seems to have lived subsequently to Oribasius (360 p. Chr. n.) and Ætius, but before Paulus Ægineta; but it is, perhaps, not possible to fix the exact time and place of his existence. His work, written in the Greek language, entitled 'Twelve Medical Books,' was missed for upwards of a thousand years, and after having been discovered, it was for the first time published at Paris, by Stephanus, in the year 1548, in folio, together with a Latin translation. In the following year, 1549, was published another translation, by J. G. Andernacus, and dedicated to Cranmer, Archbishop of Canterbury, who, as will be remembered, had then been constituted by Henry VIII one of the principal licensing authorities for the practice of physic. This translation, of which the full title is 'Alexandri Tralliani, Libri Medicinales XII. De graeco nunc primum conversi per J. G. Andernacum, Argent.,' 1549, 12mo, contains, in the second chapter of the eighth book—which treats of the obstruction of the liver—the following passage:—"Nam humores nimium exiccati assatique, lapidum instar concreverunt, adeo ut non amplius discuti potuerint." This notice of dried-up humours, concreted like stones, leaves little doubt that its author was aware, either from personal observation or from information derived from others, that stones are now and then found in the liver, and the occurrence of the passage in the chapter on obstruction of the liver, makes it clear that he must have considered these "concretions like stones" as possible causes of the obstruction of which he treats.

If we admit Alexander Trallianus to have lived in the fifth century after Christ, we have four centuries to pass over before we meet with another notice of gall-stones in medical literature. About 900 p. Chr. Rhazes wrote (Rasis; Arabice, Muhamed Arrasi), and amongst the great number of articles which constituted his pharmacy he enumerates the gall-stone of the ox. Gesner, in his work, 'De quadrupedibus, Bos et Vacca,' G., lib. i, Francofurti, 1602, p. 64 (the edit. princ. was published in 1551), has thus quoted what the Arabian says about the concretion:—"In the gall of the ox something resembling a stone, of the shape of a ring, is found, which philosophers call alcheron; ground and drawn into the nostrils, it promotes the sharpness of the eyes, &c. If this alcheron cannot be had, a sesquidenarius of the bile of a black bull may be substituted. —Rasis." And lower down, *voce* Taurus, G., lib. i, p. 96, Gesner says, "That alcheron, a hard, stone-like substance, which is found in the bile of cattle, is useful to those who suffer from epilepsy, and promotes the sharpness of the eyes, and prevents that any humour collects in the eyes, we have taught above, in speaking of the ox, according to Rasis."

About a century after Rhazes, the Armenian Avicenna began his practical and literary career. He knew the gall-stones of the ox, and used them as a remedy in various complaints. I quote the passage referring to them from the following magnificent edition of his works which is in the library of the Royal College of Surgeons:—'Avicennæ, Arabum medicorum principis (opera), Ex Gerardi Cremonensis versione, et Andreæ Alpagi Bellunensis castigatione,' &c., Venetiis, 1608, lib. ii, p. 314:—"Gall-stone of the ox.—What is an ox-gall-stone? It is a stone which is found in the gall-bladder of the ox, of the size of a hen's egg, and of a citron-yellow colour, drawing towards the red; and it has a bitter taste, biting the tongue; and it is of a light weight; and if it remains for a long time, it becomes broken up."

After this definition follows a statement regarding its medical value in various complaints. This is serviceable as containing references, first to Europus, who is said to have recommended gall-stones in epilepsy, and next to Galenus, who is reported to have found them of little use, except for the head. The calculus was evidently looked upon as an accidental formation, without any reference to disease. The four chapters of which the last concludes with the above notice of ox-gall-stones only exist in the Hebrew codices; at least Andreas Bellunensis (a physician at Damascus, who had devoted thirty years to the study of the Arabian language, for the purpose of qualifying himself for the task he so eminently accomplished) could not find them in any Arabian codex. In the edition which Gesner refers to, these four chapters were inserted at the beginning of the second book; in the edition, however, from which I have been quoting these chapters are appended, not premised, to the second book. No notice of the *lapis fellis tauri* is to be found in the index to the work of Avicenna.

Avicenna wrote about and after the year 1000 p. Chr. nat.; his works were translated by Gerard, of Cremona, about 1114. About 200 years after this date we find another notice of gall-stones in the 'Liber Pandectarum Medicinæ,' by Sylvaticus ("Matthew Moretus Brixianus, Bononie in medicina et astronomia legens"), originally published in 1317. The beautiful edition of this work contained in the College of Surgeons' library is not paginated, and dated 1474. In this edition the 533rd chapter contains this passage:—"Massatum c. lapis qui invenitur in felle bovis." Gesner says in the place last quoted that Sylvaticus also terms the gall-stone "guers," and that both "massatum" and "guers" are Arabian expressions. Like most words in Sylvaticus they are perhaps unintelligible, as is also the alleged Arabian word "haratzi," mentioned by Scaliger. Neither "massatum," nor "guers," nor "haratzi," nor the "alcheron" of Rhazes, is contained in the lists of expositions of Arabian words given by Andreas Alpagus Bellunensis. On these doubts about the expressions of Sylvaticus, see Freind, 'Hist. of Physick,' 1750, ii, 265; also Reinesius, 'Variar. lection., libr. tres,' Altenburgi, 1640, 4to.

Seventy or eighty years after the pandectarian Sylvaticus the first observations of gall-stones in the human subject were made by Benivenius (Ital., Benivieni), a celebrated physician at Florence. He wrote a treatise 'On the Hidden Causes of Diseases,' which illustrates better than any other I am acquainted with that part of the first aphorism of Hippocrates, which maintains that experience is fallacious and judgment difficult. The work was not published until several years after its author's death, which took place in 1502. Perhaps the earliest edition is that which was published at Florence, in quarto, in 1507, under the title

'Anton. Benivenius, De abditis morborum causis.' A Bâle edition, in quarto, of the year 1528, is the last of four uniform tracts contained in the library of the Medical Society of London. For the following quotations I have used the edition, with annotations, in 'Remberti Dodonæi Medicinalium observationum exempla rara' Amstelodami (dated on title-page erroneously 1521, should perhaps be 1621, the dedication and preface to the reader being dated respectively 1584 and 1581, in which latter year the first octavo edition of the same work seems also to have been published). Dodoens was professor at Leyden, and flourished about the year 1588.

Cap. III.—" Stones found in the membrane surrounding the liver.—A certain noble lady had been suffering greatly and for a long time from a pain in the situation of the liver, and although she had consulted a great many physicians, she had not been able by any remedy to get rid of her malady. For this reason she was pleased to try our aid, together with that of others. We met several physicians, and discussed at great length on all sides what might be the hidden causes of the disease. However, as happens frequently in doubtful matters, we could not agree to a verdict, for some had supposed an abscess of the liver, others a degeneration of that organ; we ourselves, however, believed that the fault was with the covering membrane. When she, after a few days, during which the illness increased upon her, had departed this life, as we had, from the certain signs, foretold by common consent, we procured the opening of the dead body. And there were found small stones, differing in shape and colour, which had been collected in the lower part of the membrane of the liver. Some stones were round, others angular, others quadratic, as position and accident had effected it; some had red spots, others were distinguished by blue-and-white ones. By their weight they had formed of the covering of the liver a small sac, of the length of the hollow of the hand, and of the width of two fingers. As we believed these to have been the cause of death, we judged it vain and useless to dispute on obscure matters."

Annotation of Dodonæus.—"It sometimes happens that stones are found in the gall-bladder, as is stated below in the 94th chapter; but that the membrane of the liver becomes relaxed, and stones are hanging down in that, is one of the rarest occurrences. I recollect to have seen the livers of some who had fallen from icterus into ascites so hard, and so full of little stones everywhere, that they could not be cut through with the knife. Andreas Vesalius, in his letter to Roelants, on the China root (smilax, a kind of sarsaparilla), relates something similar of a certain Belloarmatus, a Senensian, whose liver was found entirely white, and not of an even but of a very uneven surface, and roughened with projecting tubercle; the front part, however, and the entire left lobe were indurated like a stone."

The cases of Dodonæus look more like cases of cirrhosis than instances of liver-stones. The description of Vesalius also, as here given, of a case of indurated liver, would appear to have no reference to gall-stones. But it is extraordinary that this quotation from Vesalius is not complete, inasmuch as the account of the eighteen gall-stones found in the gall-bladder in the same case is omitted. This could not have occurred had Dodonæus quoted from the work of Vesalius directly. Donatus, in repeating the first case of Benivenius and the first part of the annotation (Scholion) of Dodonæus omits all mention of the reference made by the latter to the passage in the letter of Vesalius, and he consequently already judged that this passage of Vesalius had no reference whatever to gall-stones, and, like Dodonæus, he did not read the passage in the work of Vesalius.

If the account of Benivenius's first case might make the reader suspicious that he was ignorant of the existence of a gall-bladder in man, and mistook it, filled with calculi, for a morbid formation, this suspicion will be set at rest by the perusal of his second case, which in Chapter 94 is thus related :

"A calculus in the gall-bladder.—There died in these days a noble lady, of the name of Diamantes, struck down with the pain of stone (in the bladder). But as she had not before suffered any injury from it, the physicians thought well to open the body. And there were found very many stones ; none, however, in the (urinary) bladder, as was believed, but, with the exception of one, of a black colour and the size of a dry chestnut, which was contained in the gall-bladder, all the others were in the skin by which the liver is covered, out of which they had formed a little sac, in which they were hanging as in a bag. As we believed that this was the cause of death, we concluded that it was the prudence of a wise man to make himself no opinion at all about the uncertain and occult diseases." Annotation of Dodonæus.—"Calculi which have been formed in the gall-bladder we have ourselves also observed. Those (who suffer from them) become of a yellowish colour, are troubled with nausea and disinclination to food, and are long in bad health."

A similar case is recorded by Peucerus, the son-in-law of Philip Melanchton, and a most learned man ('Lib. de Præstig. mediocr.,' p. 316) :—We recollect that a large stone was taken out of the liver of a friend (who had died at Paris and been eviscerated), which by its livid-yellow colour showed that it had been coagulated in part from phlegm, in part from melancholic humour." He recorded the same or another case in his commentary ('De divinationum generibus'), and gave an account of it to Kentmann. In this case of Hieronymus Scriba, who was tutor to Count Valerius Cordus, and died at Paris in 1547, three calculi were found in the liver. One of these stones, says Kentmann ('Libell. de Calculis') was of about the size of half a pigeon's egg, entirely angular, of a livid colour, and made up of phlegm and melancholic humour. The calculi adhered to the flesh of the liver, so as only to be covered by the covering of the liver; all were moderately hard (Schenckius, edit. of 1609, p. 453).

Andreas Vesalius, in his epistolary treatise entitled 'Radicis Chinæ usus,' 1546, already referred to (I quote from the Leyden edition of 1547, in the library of the Medical Society of London, p. 249), gives the case of Belloarmatus, an eminent advocate, as an illustration that the spleen could perform the function of the liver. The advocate had listened to a lecture by Vesalius on the obstruction of the hepatic and cystic ducts, had then consulted the great professor in the library, where he was sitting with his students, and had proposed to come to the dissecting-room the next day, and to observe diligently those parts. He was, however, suddenly taken with illness and died. On dissection, Vesalius found that he had succumbed to hæmorrhage into the peritoneum, proceeding from an abscess, which had corroded the caudex of the portal vein. The liver was found as above stated, and softened near the abscess. The gall-bladder was unusually yellow, and in it were contained eighteen calculi, very light, of a triangular shape, with even edges and surfaces everywhere, green by colour, and somewhat blackish. But when they were dry they looked more ash-grey coloured, and by their bulk reminded of chick-peas. The spleen was very large.

Vesalius relates another no less remarkable case, namely, that of Prosper Martinus, a Florentine noble, who had for many years suffered from jaundice. He had at last died rather suddenly. Vesalius was riding past his house, in which some surgeons had already begun the post-mortem examination of the dead man, when some friends requested him to assist at the dissection. The stomach appeared to contain nothing but bile; the liver was contracted and condensed by a scirrhus; the spleen was softer and larger than natural. The gall-bladder was of about the size of two fists, and was in a manner filled with exceedingly small stones, which resembled agglomerations of grains or seeds of millet, or rather to the surface of the common rough tutia (rough oxide of zinc) of the apothecaries' shops. Veins and arteries contained a fluid which, if it was not bile itself, at least coloured the hands like bile.

The next work in which gall-stones in man are referred to is 'Gabrielis Falloppii, Medici mutinensis observationes anatomicæ,' Venetiis, 1562. Fol. 178 *b* of the splendid edition in the library of the Medical Society of London has the following passage:—"In the history of the gall-bladder, I should like to discuss with you (Petrus Manna, a physician at Cremona, to whom the observation was addressed) the concretion of numerous and large stones, which I have often and often found, as well in the gall-bladder itself as in the wide duct which leads from the liver to the intestine. But this place will least allow it."

That Fallopia knew gall-stones already in 1559 is evident from a passage in Dominicus Leonus, 'De arte medendi,' lib. v, cap. vi, where it is said, "that the great anatomist, in the said year, while teaching anatomy in the public gymnasium at Padua, found five stones suspended in the liver, which were little distant from each other, and of the size of peas; the teacher showed them to all the scholars present." In the seventh chapter of his 'Tractatus de fossilibus,' Fallopia makes an attempt to explain the nature and formation of gall-stones, which ends in a lamentable failure.

Contemporaneously with Vesalius and Fallopia lived and wrote Fernelius, physician to the King of France. Unlike Benivenius, who, instead of profiting by an anatomical experience, contented himself with drawing a sentimental moral, this physician, having made the observation of gall-stones in the human subject, continued to observe, and became the first to notice the expulsion of these concretions by the spontaneous efforts of nature. In his work 'De morbis universalibus et particularibus,' which he wrote in his most flourishing time, namely about 1558, there occurs in the chapter devoted to obstruction of the liver the following hypothesis regarding the origin of gall-stones (p. 225 of the edition of 1645) :—" Sometimes also yellow bile, which has been, contrary to nature, longer retained in the liver, and not been cleared out at the proper time, becomes very thick, and induces serious and very dangerous obstructions of the liver, so that (as we shall presently show) it becomes at times even transformed into stone in the gall-bladder." To this sentence there is the marginal reference, " Galen v, de loc. affect." 7.

On page 232 is a separate chapter on " Stone in the Gall-bladder."—" Sometimes a calculus grows in the gall-bladder, which is black, but light, and when immersed in water it floats upon it, and does not sink in it like that which is voided from the kidneys or the bladder.

" It originates from yellow bile, which, for a long time retained in its own receptacle, and not evacuated in proper time, and not renewed by an influx of fresh bile, becomes hard to a wonderful degree. This happens particularly when both ducts of the gall-bladder become obstructed.

" Of this there are neither manifest nor grave symptoms known by which it could be detected with certainty and ease. But it must be suspected in those who have had long and serious jaundice.

" Some decrepit old man, who was very much inclined to be angry, was after his death found without bile and without gall-bladder, in the seat of which latter a very large (ingens) calculus had become concreted.

"In several who, after prolonged jaundice, became affected with diarrhœa we have even observed that innumerable calculi of this kind, like peas or barley-corns, were expelled."

Realdus Columbus (professor at Padua), in the fifteenth book of his work 'De re anatomica' (first published in 1559) which is headed "De iis quæ raro in anatome reperiuntur" (p. 491 of the Paris edition of 1572), has given the following account of his observations regarding calculi, more particularly gall-stones:

"I have withdrawn with these hands innumerable stones which were found, of different colour, in the kidneys, in the lungs, in the liver, in the portal vein, as you, Jacob Bonus, have seen with your own eyes in the venerable Ignatius, the General of the Congregation of Jesus. . . In the gall-bladder of several persons also I have found several stones of different colours and shapes."

In the edition of Donatus which I shall have to describe presently, the passage referring to the calculi found in the portal vein of the general of the Jesuits is repeated verbatim, as if Donatus himself made the appeal to Jacob Bonus as an eye-witness. The sentence is parenthetically placed into another in such a manner that it gives no sense, and that its meaning can only be made out by a direct reference to Columbus. I cannot decide whether this blunder is due to Donatus or his "expurgator," Horst. Error, however, is an avalanche, becoming thicker by rolling on. The Latin of Donatus is bad, even after the expurgation by Horst of "innumerable errors regarding words and matters." But it is still correct enough not to serve as an excuse for such egregious perversion of names, authorities, and matters as is exhibited in the three following lines of Buisson ('La Bile', German edit., by Platner, p. 64): "And, according to Columbus, a gall-stone is said to have made its way into the portal vein in the body of Bonifacius (sic!) Loyola." The calculi found in the portal vein of Ignatius were not gall-stones, but vein-stones (phlebolithes); it is clear, from the sentence itself, that Columbus interpreted them as such, being well aware of the occurrence of concretions in veins as independent formations, and expressly mentioning their discovery in the hæmorrhoidal veins.

In 1551 Gesner had already given (as quoted above, under the parts referring to Rhazes) all that was contained in Rhazes with reference to the gall-stones of cattle. In his work 'De rerum fossilium &c., figuris,' which, together with a list of the fossils contained in the collection ('Arca rerum fossilium') of Joan Kentmann, a physician at Dresden, was published at Zurich, in 12mo, in 1565, under the title of 'De omni rerum fossilium genere,' Gesner referred to what he had formerly said in his 'Natural History,' and added the references to Avicenna, Sylvaticus, Scaliger, and Moses Kimhi. He also stated that he possessed such a calculus (from the ox), which was friable, of a yellowish-red colour, and had been sent to him by a friend. Not a word is said about calculi from the human subject. The list of Kentmann does not even contain a reference to gall-stones from the ox; not a single concretion from man or animal is mentioned; so that I suspect his system at that time excluded such concretions from the class of fossils.

Kentmann deposited his observations on the subject of our inquiry in a special treatise, 'De lapidibus in humano corpore repertis.' He there gives the description and engraving of a stone in the liver. He noticed the concentric arrangement of layers, a point which Morgagni afterwards worked out with such extraordinary minuteness. The book was published at Zurich in the year 1565, the same year in which the work on fossils appeared, after the completion of which both Kentmann and Gesner died.

"Kentmann (says Coe, p. xii) wrote a very small tract on twelve sorts of calculi found in different parts of the body, to which he added plates exhibiting the various figures of them, and among the rest speaks of those of the gall-bladder. The account he gives of them is (as will be seen below) very short, but he describes their size, shape, and inward texture better than any other author I have seen of his time or indeed of the remainder of that or the succeeding century." Coe also erroneously remarks that Kentmann's treatise was not published by itself, but in Gesner's book ('De omni rer. foss. gen.'), and in the year 1565, and thereby accounts for the circumstance, which is a matter of surprise to him, that so little notice was taken of it by medical men, who derived all their information about gall-stones from Fernelius, or ascribed to him all the merit of their description, notwithstanding that all Kentmann had said about gall-stones was transcribed and quoted by Schenckius in his collection of observations.

The hypothesis which Kentmann propounds relative to the origin of gall-stones is peculiar, and, singularly enough, couched in very bad Latin phraseology. Bile, he says, was burned by the heat of the liver, and concreted to a calculus in the gall-bladder, whence he himself had known them to be taken (sc. calculi). It was not less true that these calculi caused great obstructions in the vessels and many violent symptoms, about which the most experienced physicians might be in doubt. He continues, that as physicians had become more careful about their dissections, they had not only found two or three, but sometimes hundreds, of such stones in the same receptacle. He also expresses his belief that if physicians would more frequently obtain permission from the relatives of dead persons to dissect their bodies, they would find things useful and worthy of note.

He then gives a general systematic description of biliary calculi :—" The stones which form in the receptacle of the bile are in size equal to lentils, peas, beans, filberts, the joints of fingers, or even walnuts; in shape one part is round, another angular; the latter are pentagons, or heptagons or octagons, or even of more angles, (" gon" is here erroneously used for " hedra," as " angle" is for " side"), for the more calculi are found together the more angular they are; all are light like tophi, with a colour inclining towards yellow, which, as the stones increase, is changed to yellow. They are moderately hard; broken, they appear inside of a reddish-yellow colour, full of narrow circles going round each other, so that every one can see how slow and viscous bile has adhered to the centre and to the surface, and has grown gradually around it, and has by the heat of the liver been indurated to such hardness."

Kentmann then relates a case, and describes its symptoms with unusual minuteness. A student, on his return from Italy to Leipzig, began to be troubled with pain in his stomach and right hypochondriac region, and with nausea. He was thin, and had always been subject to constipation of the bowels, symptoms which deprived him of sleep, and thus produced lassitude of his limbs, low spirits, melancholic affections, and emaciation. He used many remedies, which the most learned doctors prescribed for him. But they were all in vain, as nobody saw correctly the cause of the disease. Several of his physicians and friends believed that he had swallowed a φιλτρον (love-potion) in Italy. He died in 1551, aged 29. On dissection, his organs were found healthy, the heart alone excepted, which was atrophied. In the gall-bladder, however, twenty-two calculi were found, of a yellowish colour, differing in size from that of a pea to that of a bean. They had five, seven, eight, or even more angles (corners).

Kentmann then records that from the gall-bladder of King Christian of Denmark, who died in the year 1559, a large number of gall-stones of a similar shape were excised.

Another historical personage, Frederick the Third, with the surname the Wise, Elector of Saxony, who died on the 5th of May, 1525, was found, at the examination of his body, to have a large gall-stone in his gall-bladder, besides calculi in the urinary bladder and the right kidney. The dissection was performed by the surgeon of the Elector, Joannes Trautemann, and his heirs kept the calculi as heirlooms. Peucerus, who related the occurrence to Kentmann, added that he had had the gall-stone in his own hands. Its colour was green, like leek, its shape square (cubical), and its size that of a joint of a finger.

Kentmann finally alludes to the finding by Fallopius at Padua, in 1562, of a calculus of the size of half a hen's egg in an anatomical subject.

The first systematic collection of data referring to gall-stones in the human subject was made by Marcellus Donatus, in his work 'De Medica Historia mirabili,' Mantuæ, 1586 (Horst's edition, 1613). From this book I take the following data, most of which I could not verify by reference to the original works, as they are not to be found in any of the principal medical libraries of the metropolis. It must, of course, be understood that any data taken from works published subsequently to Donatus's own lifetime have been inserted by his various emendators, among them Horst himself. The work of Donatus must have been of great value to his contemporaries, if I may judge from the value which in a literary and material sense it still possesses in the present day.

Lib. iv, Horst's edit., p. 520.—*Calculi* (probably gall-stones) *rejected from the stomach.*—" That a stone is sometimes generated in the stomach is testified by Gentilis (da Foligno, Lat., Fulginatus, died 1348 ?) in 'Comment. ad cap. avic.,' lib. iv, fen. 1, tract. 2, " De febre sextana et septana," as reported by Nicolus, s. 5, tract. 4, c. 53, who relates the following history :

" ' Magister Jo. Juliani de Furlivio sent me a stone of the size of a nut, which had been expelled by vomiting after pain in the stomach. The hardness of the stone was above that of plaster, as put up in buildings, and the shape was like that of an egg.'

" Gilbert, as reported by the same Nicolus, has written that he had seen a stone rejected by vomiting, which had been formed in the stomach."

(*Biliary*) *calculus voided by the bowels.* — Cornelius Gemma (' Cosmocrit.,' lib. i, capit. 6), writes.—" A certain woman, after long-continued pain in the stomach, voided a triangular stone from the intestines, which was of the bulk of a chestnut. I believe it to have lain hidden in the pylorus for an entire year, as was shown by the succession and nature of the preceding symptoms."

Calculus in the liver.—" In the body of the celebrated Duke of Venice, Augustinus Barbaricus, a stone was found formed in the liver when the intestines were withdrawn by the chirurgeon." The following are Gemma's own words : —" When, at Venice, the body of Duke Augustinus, of the family of Barbadico, was dissected, in order to remove the intestines, a stone of the size of a large olive, of a colour like serpentine, with a tendency to black, was found near the gall-bladder." — Cælius Rhodiginus (lib. iv, cap. 17), 'Ant. Lect.' The same story is told by Cardanus, probably after Cælius, but he makes the size 'larger than the nucleus of an olive.' (Cardanus, lib. viii, cap. 44, "De rerum variet.")

Donatus then repeats the accounts of Benivenius and Dodonæus, and continues:

"Scaliger (Julius Cæsar, about 1558), in the place already quoted ('Ad Cardanum exercit.,' 108, num. 3), writes, that he had seen a very hard stone, of a light flesh-colour, withdrawn from the liver of a rower; and that in the liver of a certain senator black stones had been found, which, when thrown in water, swelled (or rose) up.

"Mathiolus (Peter Andreas, physician to the Archduke Ferdinand; his works published in 1598), lib. epist., 5, ad Iac. Camnicenum, writes, that in the liver of Aurelia Petrucia, the old wife of Pandulfus the Tyrant (Prince), a stone of the size of an almond nut had been found. Trincavellius (Victor Trincavella, professor at Padua, 'Opera omnia,' publ. 1598), himself has noted this down ('De ratione curand. part. hum. corp. aff,' lib. x, c. 6).

"We ourselves, when engaged at Venice in the dissection of bodies, found in some of the subjects which we dissected in the hospitals there some stony hardnesses concreted in the liver."

The paragraph concludes with references to Columbus and Kentmann.

Donatus (loc. cit., p. 521), continues—"Calculi in the gall-bladder.—In the gall-bladder several stones have been observed. Thus, Gentilis affirms that he found in the passage or duct ('seu porum, seu ductum dicas, nihil interest,' Columbus, lib. xi, cap. 8) of the gall-bladder of a woman whose intestines had been taken out in order that the body might be embalmed, a stone of a greenish tinge. Recent writers have truly observed that such a condition might produce jaundice; and Nicolus, a physician at Florence, who lived in the fifteenth century, in the place quoted above, gives out that he had seen a stone formed in the gall-bladder of the wife of Gianozzo de Pandolphini." (Compare the observation of Matthiolus upon the wife of Prince Pandulfus, above.)

Donatus then relates the second case of Benivenius, and the annotation of Dodonæus, and then continues:

"Camnicenus, in the letter mentioned, testifies that after the death of George, king of Bohemia, his gall-bladder was taken out, and instead of bile it contained a stone, which was similar to hematite in colour.

(Coe, Preface, p. 9).—"When Camnicenus, not long after (Fernelius wrote), had found biliary calculi in the body of a man who died of a jaundice and dropsy, he writes to Matthiolus ('Matthiol. Epist.,' lib. v, p. 184) as an oracle, to be informed about them, at the same time mentioning a very remarkable stone, found in the gall-bladder of George, king of Bohemia, which he says was still preserved in his time, and was probably of an older date than the case related by Benivenius." (Coe does not know the first case of Benivenius. Page 10, foot-note, continues:—) "Matthiolus, by his reply, seems to know little about them himself, though he readily undertakes to account for them, and he quotes the statement of Fernelius. He seems to have been much better acquainted with the gall-stones found in oxen than with those in men, and says that he had received many from the butchers, which he had applied for the cure of various diseases of the human body."

Donatus then gives reference to Duretus (see below), and to Kentmann. He relates further, that "in the gall-bladder of Vincentius de Rubeis, who died in the year 1574, an almost countless number of stones was found, some were blackish, some yellowish, some were the size of peas, all others were smaller." After a reference to Columbus, the case of Fernelius's old man, who had no gall-bladder, but merely a large calculus in its place, is repeated, with the exclamation that this "almost surpasses belief."

Donatus makes no mention of Tornamira as having noticed anything connected with gall-stones, though under the chapter on calculus in the urinary bladder the name and work of this physician (Praxis, C, "De lapide") are repeatedly noticed.

Jacobus Hollerius (physician at Paris, 'Op. omn.,' published with his own and Duretus's annotations, anno 1623) in 'De morbis internis,' lib. i, cap. 48, "De calculo," in a scholion of his own, says that he found fifty-three calculi in the gall-bladder of a noble lady of the name of Arvernia. Lower down he says that Musa (physician to the Roman Emperor Augustus) knew of a woman who had passed five calculi by the anus, and thinks it a very probable story, because he has by his side the hypothesis of the inspissation of intestinal mucus as accounting for the formation of intestinal calculi, just as before 1860 medical authors sought the origin of gall-stones in the inspissation of the mucus of the biliary passages.

The enarrations, and annotations to the enarrations, which are throughout this work added to the main chapters and scholia of Hollerius, have for their author Ludovicus Duretus, physician to the King of France, a pedantical Galenist, but a learned man, and much influenced by the rise of anatomy as a science. In the annotation to Hollerius's chapter "De calculo," he says—"In the gall-bladder it (calculus) is not new. In Madame d'Entragues we have found twenty-two calculi, which in colour and consistence resembled jet;*) and, as regards shape, formed trilateral pyramids, with equal sides (tetrahedra). In the most illustrious mother of the Prefect of Paris we have, on dissection, seen two calculi, which imitated the shape of a large, dried, blue prune. In the wife of D. Moreau, the Treasurer of Paris, we found three calculi in the gall-bladder, of the size of a thumb. She was jaundiced."

In the year 1609 the work of Schenckius, 'Observationum medicinalium volumen,' was published. In it was collected much of the literature of original observations on the subject, distributed under two heads—the one being "Calculi in the liver;" the second, "Calculi in the gall-bladder." Under calculi in the liver, those which take their origin in its substance are properly distinguished from those which take their origin in the veins of the liver. When speaking of the observations of Realdus Columbus, I have already had occasion to correct a common misapprehension of authors (it was in these days repeated by an author, 'Med. Times and Gazette,' May, 1862), that Ignatius Loyala had died of the passage of a gall-stone into the portal vein. A similar misapprehension exists with regard to Felix Platerus ('De observ. propriis'), quoted by Schenckius. This author says, "That in the liver, not only of man, but also of the other animals, particularly the horned ones, and those which like salt much, copious gravel (arenulas) and calculi and tophi are frequently found, is taught by dissection and daily experience. Besides gravel, which was now red, now gray, at other times yellow, and variously shaped and coloured calculi, I have also cut

* "Gagatinos," from "găgātes," æ. m. (Plin., 36, 19, 34), a kind of firm asphalt, verging upon coal; in German, "Gagatkohle," "Glanzkohle," (according to Leonhardt, 'Oryctognosie,' not "Glanzkohle," but "Pechkohle"); French, "jayet," or "jais;" Engl., "jet."

out of the substance of the liver a coral-like, branched, white tophus, which internally was hollow, and filled with black blood. These serve as a document that many obstructions and indurations of the liver, which are followed by cachexia and dropsy, do not only proceed from humours, but also from bodies of this kind, of which the practitioners do not think. When they come to be of some size, they cannot be spontaneously expelled from the living body, nor taken out by any art, and remain abstruse to us, and are buried with the patients. The cause thus remains unknown."

From the context alone there can be no doubt that Plater considered the coral-like body not to be a gall-stone. That it was white, internally hollow, and filled with black blood, sufficiently stamps it with the character of a venous concretion (phlebolithe), and all the contrary surmises and differing commentaries of Buisson and other authors fall to the ground.

Schenckius further reports observations of calculi in the liver by Cyriacus Lucius, Turneiserus, and several others which we have already mentioned.

The second chapter of Schenckius, devoted to gall-stones, treats of concretions found in the gall-bladder, and has the following grotesque superscription :

" Horrible and stupendous calculi, coagulated in the gall-bladder ; their shape, colour, number and wonderful effects, producing vomiting, nausea, heaviness, low spirits, tearings of the stomach and hypochondria, atrophy, tabes, obstruction of the viscera, inflammation, incurable jaundice, sleeplessness, lassitude, sadness and melancholic affections, inclination to anger, difficulty and heat of urine, lepra of the skin, fever, sudden death, by a hidden and generally unknown seminary and foment of diseases and symptoms."

This chapter opens with extracts from Kentmann, and after these quotes the remarks and observations of Fernelius. A case related by Langius, epistola 57, tom. 2, is next given. Then follow two cases described by Coiter, in "libell. observ. anat. et chirurg.," of persons who had died after having for a long time suffered of jaundice, of which the cause was found, on dissection, to have been an accumulation of gall-stones in the gall-bladder and gall-ducts. This author also mentions the case of a woman who recovered from a very protracted jaundice after she had passed calculi in her excrements. This case is succeeded in Schenckius by those of Vesalius and Benivenius, and the annotation of Dodonæus. Some sentences from Cardanus follow, of which the first one only should properly stand where it is, as it contains reference to a man who had suffered of that kind of scabies which is called lepra, and was found to have a gall-stone in his gall-bladder (lib. vii, "Subtilit"). In the third quotation, from Cardanus, there appears to be no question of gall-stones, but only of an enlarged, so-called dropsical gall-bladder. Next follow quotations from Fallopius. Then another version of the case of Scriba (Schreiber), already alluded to on the occasion of the experience of Peucerus and Kentmann, is given. Crato, in a letter to Gesner which is prefixed to the works of Cordus, says that he had heard from Joan. Pontanus, that a very large calculus had been found in Scriba's gall-bladder.

Ferrandus brings two cases very similar to that of the Elector of Saxony. In the year 1567 he dissected a nobleman, and found five calculi in the urinary bladder, one in the gall-bladder, and one in the right kidney. On the 2nd of June of the same year, he found in the body of a military man of high rank a calculus in the urinary bladder, surrounded by a putrid fluid representing pure pus, several calculi in the kidneys, and one black, oval, rough, and small calculus in the gall-bladder.

To this succeed some remarks of Gemma from 'Cosmocrit.,' lib. i, cap. vi, which I have not quoted above, although I have given some cases related by Gemma in the same place, after Donatus, which cases, strangely enough, are not given by Schenckius. Gemma states his general experience that he had found calculi in the gall-bladder, caused, he believed, by inflammation of the nearest intestines, or by long-continued obstructions. They were angular, black externally, internally yellowish, and frequently of various colours. Out of a dropsical person he took thirty-two calculi, of which the smallest corresponded to the size of a pea, the largest to that of a filbert.

After a reference to the scholiographer of Hollerius, Schenckius reports the statement of Turneiserus (lib. "De Urinis"), according to which, in the gall-bladder of the Markgraff John of Brandenburg, a green calculus of the size of a walnut was found.

As confirming these data by similar experience, the names of several authors are mentioned, some of which I have already quoted. Others we here learn for the first time, *e.g.* Arculanus, Alex. Benedictus, Monterus, Thom. à Veiga, Scholiograph. ad libell. Gal. de loc. affectis.

Further observations quoted by Schenckius—Forest, schol. ad observ. 26, lib. 14; Solenander, in 'Cons. med.,' sect. v, cons. 16 (calculus found in the gall-bladder of the Duke of Cleves); the same, cons. 15, relates that, anno 68 (query 1568), a hundred calculi of the size of seeds of the pomegranate or of Indian corn, were taken out of the gall-bladder of Henry, Duke of Brunswick. A case from the observations of Joachim Camerarius is next in order, in which 143 calculi in the gall-bladder, scirrhus of the liver, and enlargement of the spleen to the size of the liver, were complicated with calculi in both kidneys and a rupture of the size of a head. Then follows another fatal case of gall-stones observed by the same Camerarius. After that Johannes Jessenius à Jessen brings an experience which he made at Padua in 1590—"Fabricius ab Aquapendente was lecturing on anatomy, and using a jaundiced subject for demonstration; in the gall-bladder numerous concretions were found, the spleen being small; the great chirurgeon thereupon constructed a theory of gall-stones as follows:—That the liver, while the spleen was inactive, had drawn the fæces of the blood through the portal vein, and had sent the excrement into the neighbouring receptacle; as this could not rid itself of the incumbrance by the ordinary outlets, all that was earthy had been united and hatched by the heat of the liver; the rest, however, which was not caught in the gall-bladder, had been carried with the blood to the veins and other parts of the body, and coloured the skin." This memorandum of Jessenius was sent to Schenckius by Larent. Scholzius; it is, therefore, not altogether fair to let Fabricius carry the whole burden of the doctrine.

The same Scholzius at the same time communicated to Schenckius an observation of his own. A smith in Breslau had for a year been suffering of gall-stone, pain, and jaundice. At last he passed the calculus by the bowels. The learned Scholzius wonders by what passages this gall-stone, which appeared to him of the shape of the gall-bladder, had got into the intestines. Then follow three cases related by the Florentine physician, Neretus Neretius. The first was fatal, with jaundice, the gall-bladder was full of calculi; in the other two cases calculi were found, without there having been any jaundice during life. The last but one observation is by Joann. Francus Hildesius Camnicenus (not to be confounded with Jacob Camnicenus, quoted above), who found many calculi in an aged female which he dissected at Montpellier. The last observation is that made by Joan. Fridius, on the body of Count Philip of Hanau, in whose gall-bladder upwards of one thousand calculi were found. Georgius Graseccius, who has preserved the record of it in his anatomical work, saw them himself, with some others which Fridius exhibited to him.

Among the observations referring to the common duct there is one made by Joan. Frid. Traffelmann upon the body of the Archbishop Daniel of Mayence. The common duct near the duodenum was found full of small calculi; the larger ones were of the size of a nutmeg, the smaller ones of the size of shot.

From the foregoing it is sufficiently apparent that, subsequently to the time of Kentmann and Fernelius, most writers on anatomy and pathology mention gall-stones; "the systematic writers in physic," says Coe (p. 14), "speak of them as one cause of the jaundice; but, copying from Fernelius and from one another, take it for granted that the signs of them are not very evident, and that when that disease proceeds from this cause it is quite incurable. And perhaps it was because the signs of them were so little known that Lommius, that excellent writer about diagnostic and prognostic signs, only just mentions them, and almost in the words of Fernelius."

On p. 17 Coe continues—"Most of the great physicians of the last century just mention calculi, when speaking of the jaundice, as one cause of that disease. Sennertus, Riverius, Etmullerus, Sylvius de le Boe, Willis, Baglivi, and others, speak of them in this manner. Some of them indeed, do observe that, when the jaundice is of long standing and very obstinate, or especially if there have been frequent returns of it, these are signs that it arises from this cause. And this seems to be all that so late a writer as Baglivi knew about the signs of them. He says, perhaps too positively as to the cause, and certainly so as to the incurableness, of the disease, 'If you see a pertinacious icterus, or one which relapses after it has got well, you may hold it for certain that it proceeds from calculus in the gall-bladder, and you may predict as incurable what the dissection of the body will teach you.' ('De Bilis Natura')."

"Moreton, a physician of great practice in London towards the end of the seventeenth century, had some knowledge of the intense pains these calculi occasion, though he calls them by the general name of colic pains; and from those pains, joined with the jaundice, he sometimes pronounced that there were stones in the gall-bladder, which were accordingly found upon opening the bodies. But yet he seems to have had no notion of their being discharged by stool, or of any method towards attempting a cure.

"It does not appear that Sydenham, though so careful an observer and so great a practitioner, knew anything at all about these calculi; at least he never once mentions them in all his writings (see Sydenham, 'De colica biliosa')."

Boerhaave was well acquainted with the symptoms produced by gall-stones, but not with the issues of the disease. A manuscript copy of his lectures, which Coe saw, had the following note, purporting to have been taken from his mouth:—" I for a long time wondered what should be the cause of a jaundice preceded by violent anxieties, vomitings, pain, and convulsions, and that all these symptoms should go off, and after a while return again, till at length opening bodies taught me that in these cases the biliary ducts are obstructed by calculi. Hence the bile, not finding a passage, is accumulated to such a degree as to cause those anxieties. But when, by the violent vomitings, the bile is so far exhausted, being partly forced out through the ducts and partly into the vena cava, and from thence all over the body, so as to be reduced to the ordinary quantity, all the complaints cease."

"Some other late authors (says Coe) who knew these calculi well as anatomists, seem to have taken little or no notice of them as practitioners. The celebrated Ruysch was acquainted with them as occurring in dissections, and gives some instances of their being found in opening morbid bodies. He had also seen some that were discharged by stool, but says not a word of any symptoms they occasion, or that he ever had observed them in patients. Morgagni, likewise, that accurate professor of anatomy at Padua, who had seen as many of these calculi as any man, and describes their figures and other properties more exactly than any author had done before him, was very little acquainted with them in living bodies, or aware that they often produce any sensible effects, or are very frequently voided by stool. He knew that some physicians had spoken of their discharge, and even quotes Fernelius for that purpose. And he mentions one calculus that he had seen in the possession of Valisnerius, which was voided after excruciating pains in the stomach, from which instance he seems to have taken occasion to write about them. For he says that as every one who saw it did not know what it was, he thought it right to give a description of them, that they might be known by others when they are seen to come away. He also criticises upon the reports of Columbus, Vesalius, and Camnicenus, of calculi being found in the vena portarum. These he suspects were really in the bile-duct (an assumption which, as the reader already knows, is precluded by the tenor of the reports themselves, and in every respect unfounded).

"At last, when these calculi had been more frequently observed to pass by stool, and the complaints of such patients more nicely attended to, and compared with the circumstances of those in whose bodies they were found by dissection, they came to be taken notice of by more practitioners, and to be more particularly treated of by some few authors than they had been before, who now began to consider and collect the symptoms, and to put them together, as the signs by which such cases might be known."

In the year 1670 a case was related, by Nic. Guil. Becker, in 'Misc. Nat. Curios.,' ann. MDCLXX, obs. xliv, in which seventy-two gall-stones were found in a person dead of asthma, ischiadic pain, and jaundice. Fifteen years later we meet with a dissertation published at Tübingen by one Schmidlin, which relates the case of a jaundiced woman who recovered after having discharged several biliary calculi by the bowels. In the year 1691 Pechlin published 'Obs. Phys. Med.,' lib. iii, 4to, Hamb. On p. 136 begins a chapter, "Icterus sine obstructione folliculi fellei, et obstructio ejusdem sine ictero." The latter part of the title is borne out by the case, related on p. 140, of an old woman in whose gall-bladder a great many calculi were found. Obs. l, l. 16, it is related that many calculi were discharged from the bowels of an hypochondriac man after the use of Pyrmont water. About the same time one Timæus à Güldenklee, in the third book of his work, published a case, the thirty-eighth of his series, in which arthritic pains were followed by incurable jaundice, and a calculus filling the whole of the gall-bladder was found after death.

In 1696 A. Petermann and G. Albrecht published at Leipzig a dissertation, 'Scrutinium icteri ex calculis vesiculæ fellis occasione cujusdam singularis,' which was subsequently reprinted by Haller in 'Disp. ad Morb.,' vol. iii, p. 581. These authors relate a case in which a great number of gall-stones were discharged, and the patient recovered from his illness. To that follows a physiological chapter about the liver and bile, and after that a pathological one relating to gall-stone disease. In § 2 are quoted the following cases, some similar to the first one related :—Sorbait., 'Oper. Med.,' Tract. 6, cap. 5, p. 739; the cases of Becker, Güldenklee, and Schmidlin, already referred to; Hagendorn, 'Hist. Med. Phys.,' cent. ii, hist. 8; Bonetus, 'Med. Sept.,' lib. iii, sect. 19, cap. 27 and 28 (1686). As observations referring more particularly to the size of calculi, are quoted—Fabr. Hildanus, cent. 1, obs. 60, and Cnoefel, Misc., A. N. C., 1673. To cases of distended and enlarged gall-bladder many references are given on p. 593.

In § 8, the opinion of Paracelsus on the origin of calculi is given, to the effect that there were contained in our humours particles which concreted in cavities to small calculi, like solid stones. To this opinion Helmont was violently opposed ('Tr. de Lithiasi,' cap. 3, n. 9), and made the assumption of a spirit which was to stir up the acrid humours.

Bonetus, in his 'Sepulchretum' (1700), opens the list of authors of the eighteenth century who have referred to or treated of gall-stones. Some of them are enumerated by Coe, and commented upon as follows:

"Bianchi, Hoffmannus, Theodorus Philippus Schacht, the author of the anonymous essay on the jaundice in the first volume of the 'Medical Essays and Observations;' Dr. Simpson, of St. Andrew's; and Dr. Van Swieten, first physician to the Emperor and Empress of Germany.

"Bianchi, professor of physic at Turin, in his large work of two volumes in quarto, called 'Historia hepatica' (1716), wherein he proposes to give a complete account of the anatomy of the liver and of all the diseases of that viscus, allots a part of two chapters for the subject of these concretions.

"He is not the most clear, convincing writer, is apt to speak too positively, and to draw too hasty and too general conclusions from a few particular instances. In his account of the properties of calculi he is too dogmatical, and is for making those he had seen a standard for all; so that if we believe other authors of at least equal experience and credit, we must be convinced that many things he says are contradicted by facts. And what he writes about the diagnostics and cure are by no means satisfactory. He is apt to assert some things from theory, and to dispute the plain facts of other credible authors when they do not coincide with his own opinions. Otherwise he would not have laid it down as a certain rule among his signs that the larger the calculi are the more pain they occasion. For this will not always hold true even while they remain in the bladder, and a small stone may produce more pain to one patient than a much larger one does to another, as he might have observed from a case he had just before referred to in Fabricius Hildanus. The best thing Bianchi has said on the subject are the cases he has related, some few of which are his own, but most of them collected from other writers. His cavilling disposition and his conduct as a controversial writer may be fully seen in Morgagni's 'Epistles,' and the preface to them.

"The celebrated Hoffman has written much better on this subject. But as he writes on it in his systematic method, in one chapter of his work called 'Medicina Rationalis Systematica' (tom. vi), not in a dissertation by itself, he has not treated it so fully as might be wished, and as perhaps might have been expected on a doctrine so little known or attended to at that time, and from an author who wrote so much."

From this it appears that Coe was not acquainted with the dissertation of Nitzsch, written under the presidency of Hoffmann, and containing his experience on the subject.

"The occasion of Professor Schacht's writing on this subject was his publishing ('Herborniæ Nassaviorum,' in 4to, anno 1724) the particular case of a patient who had laboured under a phthisis icteritia, and also voided several calculi by stool, which the author concludes certainly came from the gall-bladder. He does not seem to have had, at that time, much experience of these concretions in his own practice, as he speaks of but one patient more from whom he had seen them. But he quotes many accounts of them from a number of authors, both of their being found by dissections and of their being voided by stool. His theory is not, perhaps, the most clear and satisfactory, either as to the formation of biliary calculi in general, or in explaining the symptoms of that patient's complicated case. And after all he has said about the two calculi he describes and gives a print of, there may still remain some kind of doubt whether they were not of the intestinal rather than of the biliary kind; or at least, if they had their first origin in the gall-bladder, whether they were not greatly increased in bulk by their stay in the guts. The circumstances which favour this suspicion are, that the external appearance of the smallest, according to the figure he gives of it, much more resembles an intestinal calculus than a biliary one; that the very great size of the other, namely, as large as a turkey's egg (gallinæ indicæ), and of the weight of above two and three quarters ounces, exceeds all, as he justly observes, that were ever before known to pass the duct; and that the patient suffered unspeakably greater pains from the passing of the stone through the guts, even the colon and rectum, than while it was, as he supposes, making its way through the duct. The only method, perhaps, to have decided the question in what part these calculi were really formed would have been to cut them in two in the middle, to observe their inward structure, and whether they contained any nucleus, and of what kind. If they had for a nucleus the stone of a fruit, or a small bone, or the like, which could never have been in the gall-bladder, this would have proved clearly that the calculi were of the intestinal kind. And if their nuclei were evidently biliary, but the rest of their composition was like those formed in the guts, it would have appeared that they were of a mixed kind. But if the whole substance of them had been like those found in the gall-bladder, they must have been supposed to come thence, how difficult soever it is to conceive of the passage of the large one, unless it can be admitted that they might be wholly concreted, or at least very much enlarged, in the duodenum, from bile stagnating there.

"The judicious author of the anonymous essay on the jaundice in the first volume of the 'Medical Essays and Observations' has reasoned well about calculi being the most frequent cause of that disease, by stopping the cystic bile in its course to the duodenum, as also about the improbability and insufficiency of the other causes which had usually been assigned for it by medical writers. He therefore argues justly that physicians ought always to have a view to this cause when they are concerned with icteric patients, and that, when no other cause appears, the general indication will be that of expelling calculi. For which purpose, he says, 'medicines are to be applied in very near the same form and intention as are used in case of stones lodged in the ureters.' But as he does not enter into a full detail of the properties of the biliary calculi, or of the symptoms occasioned by them, or of any particulars about the cure, he was very far from designing that short essay as a treatise upon the subject.

"Dr. Sympson, also, a learned professor at St. Andrew's, in the fourth edition of that same first volume of 'Medical Essays,' &c., has published an essay on the jaundice, by which, as well as by the case of a patient related in the second volume of that work,* the doctor has shown that he is well acquainted with the effects of biliary calculi, as they occur in practice. He directs us, indeed, to look further than merely to the colour of the skin, in order to determine a case to be jaundice, since, he says, the blood may receive such a change from other causes, namely, a fever, poisons, &c., without any regurgitation or redundance of bile as to make the skin appear yellow. But when with the yellowness of the skin there is also the same colour in the whites of the eyes, the urine is strongly saturated with bile, and the stools are white, we may be sure that the course of the bile into the intestines is stopped, and that it regurgitates into the blood. And this last case only the doctor inclines to call a genuine or true jaundice. This distinction of the doctor's appears reasonable and useful in practice, for, as he says, the method of cure must be different. When the blood itself is changed by a fever, &c., without any mixture of bile, the only remedy is to cure the fever, or whatever was the cause of such a change. But when the jaundice arises from a stoppage of the biliary ducts, the cure must be by removing the obstruction there, and reducing the bile to its natural course."

After some good remarks on the possibility of a partial escape of bile in cases where the obstruction is not complete, and jaundice is accompanied by coloured fæces, Coe intimates that neither Dr. Simpson nor the other author mentioned before him takes any proper notice of that kind

* Obs. XXVIII.—Jaundice from concretions. Instructive case of a woman who, after passing many calculi by the bowels, recovered her health.

of jaundice where, from the absence of pain, we have no reason to suspect any stones, and which we see easily cured by evacuating means. Finally, however, he excuses them both, as their essays were short, and the design of them was to recommend to practitioners a constant attention to calculi, as the principal and most frequent cause of jaundice.

Van Swieten, in his commentaries on the aphorisms of Boerhaave, has shown that he was well acquainted with gall-stone disease, and has given instructions concerning it, based upon his own practice.

Coe was unacquainted with some of the most important publications on gall-stones; they were in the form of dissertations, most of which would not easily have made their way to literary notoriety had they not, with others, been collected by Haller. The oldest of these is by A. Vater and J. F. Schimmer, 'De calculi in vesica fellea geniti ratione,' Witteberg., 1722 (Haller, 'Diss. ad Morb.,' vol. vii, p. 714.) These authors give in twelve theses a general account of gall-stones, interwoven with allusions to cases in which they had themselves found such concretions in dead bodies. Bezold (G.), 'De Cholelithis,' Argent., 1725 (Haller, 'Diss. ad Morb.,' vol. iii, p. 605) describes calculi found in an anatomical subject, and gives an engraving representing the liver and the calculi in the gall-bladder *in situ,* and underneath this piece engravings of ten single calculi out of the total number of forty-six. His second case concerns a woman of fifty-two years, who for six years had been troubled with pain in the right hypochondriac region. At last, in 1699, she passed, under pain, a great cuneiform calculus. This was of the size and shape represented by the author in an engraving, and weighed one ounce two drachms and half a scruple. On section, the calculus was found of a concentric structure, and made up of friable, soft, yellow matter. It contained a crystalline nucleus, which was white, here and there interspersed with yellow points. After the excretion of this calculus the woman lived free from all her former sufferings.

Bezold quotes examples of the occurrence of gall-stones, and amongst these the following cases, not yet noted:—Horstius, 'Epist. med.,' l. ii, p. 455; Helwig, edited by Schroeck, 'Acta med. Berolinensia,' vol. v, no. 3. Bezold then gives a case of *pellucid* calculus observed by himself, and depicts the concretion in his fig. 4. He then observed that pellucid calculi were observed by Georgius Scharpius, professor at Montpellier, by Tamponet, surgeon to the king, and by Manche, the last two quoted by Nicolus de Blegny in 'Zodiac. Med. Gall.,' ann. 1, epist. 4, obs. 7, and epist. 5, obs. 8.

Bezold also quotes an observation of an extremely large gall-stone from the ox, made by Henricus Vollgnadius, and recorded in 'Ephem. nat. cur.' dec. i, ann. 1, obs. 44. This Vollgnadius at Wratislaw obtained possession of two ox gall-stones; the one was of the size of a plum, the other of the size of an orange (pomum aurantium), and weighed two ounces and two drachms.

In the same 'Ephem.' is given the experience of Becker, who found seventy-two calculi; of Fabricius Bartoletus, who found 300; and of Olaus Borrichius, who found ninety. The original observations of this Olaus Borrichius are to be found in 'Acta Haffnienses,' vol. v, obs. 65. He has already prescribed that, in order to obtain calculi passed by the living, it is necessary to wash and sift the fæces.

Relatively to the origin of gall-stones, Bezold remarks that the formation of gall-stones could not be attributed merely to an inspissation of bile, but that it required a stagnation of the bile, and an abstraction of its watery parts, and a supervention of *heterogeneous* earthy, saline, acid, and alkaline matters.

In 1726 Chr. A. Ziegenhorn published, at Wittenberg, in quarto, his dissertation entitled 'Observationes rarissimæ calculorum in corpore humano generationem illustrantes,' written under the presidency of the anatomist, Abraham Vater. Eighteen pages contain general remarks and two cases; p. 19 opens with the third observation, the subject of which was a woman æt. 50. After a fortnight's illness she voided a biliary calculus by the bowels, and after another fortnight a second one. Both calculi were of considerable size, and to judge from the engraving, must have filled the whole cavity of a large gall-bladder. The author next attempts to explain the origin of gall-stones by the assumption of an excess of saline-tartareous matters. He points out the absence of jaundice from his case, and adduces two similar cases of Neretius, mentioned by Bonetus (ser. xviii, obs. 8, §. 6). He then questions the mode in which the calculi might have passed into the intestine, and thinks it likely to have been effected by dilatation of the duct, as in analogous cases in the ureters. He mentions the case of a woman who passed a gall-stone per anum, and after her death five more calculi were found in the gall-bladder, which fitted the one which had been passed during life. He then discusses the value of remedies, amongst them the Spiritus Nitri Dulcis, recommended by Sylvius ('Prax.,' p. 436); the waters of Pyrmont, upon the basis of the observation of Pechlin; curcumæ root, as mentioned by Hoffmann, in 'Clau. Schroeder,' p. 463; and the roots of grass (radix graminis), recommended by Sylvius, who believed that the use of hay during the winter caused gall-stones in cattle, which the green grass in May redissolved. The dissertation of Ziegenhorn was not reprinted by Haller, nor was the next one we have to mention, namely, that by A. Nitzsch, entitled 'Diss. de dolore et spasmo ex calculo felleo Hal. Magd.,' 1731, 4to, and written under the presidency of Fried. Hoffmann. The author gives a general account of the varieties of gall-stones. In Chapter 8 he relates some experiments which he made to ascertain their composition. Calculi of a dark colour and solid consistence, when dry, burned when held to a candle, and gave a light flame, like resin. They left a black, ash-like matter. Those which were white and gray fused like wax on a piece of iron plate, The darker and harder variety did not dissolve in spirit of wine nor in water, even on boiling. Some soft gall-stones dissolved about one half in warm water. From ox gall-stones, the author extracted a bitter, yellow substance, by means of warm alcohol and warm water. What remained burned with a flame, and, yielding a smoke smelling of burned hair, left a black coal. From these tests he says that it is clear that the common opinion, according to which alkaline, acid, or neutral or tartareous salts concur in the generation and concretion of biliary calculi, is erroneous. In Chapter 10 he gives the hypothesis which maintains that gall-stones originate in inspissated bile. He then says that old age is particularly liable to gall-stones, also the female sex. The influence of sedentary habits is also adduced and explained at length. On the faith of Sylvius, the abuse of beer and spirits are mentioned as causes ; the passage of this later author, however, which is quoted, seems to refer to hobnail liver rather than to gall-stones. Nitzsch then mentions a case in which laxatives, prescribed to ease a calculous nephritis of several years' standing, evacuated gall-stones; these continued to pass during seven years. Another case of stone in the bladder complicated with gall-stones found after death, is related. In Chapter 13, the symptoms of the passage of gall-stones are graphically described. The symptoms of the fæces are given in Chapter 16. Chapter 17 adverts to cases of gall-stones without symptoms. Enlargement of a gall-bladder containing 366 calculi is related as an observation made by the præses (see Hoffmann, 'Observ.,' lib. xix). Chapter 21 contains a case in which concretions were discharged after a laxative, but without any previous colic. It is denied that they were gall-stones. Finally, a good many substances are discussed as remedies, among them the anodyne liquor of the præses, which alone has stood its ground in practice down to our day.

The dissertation by H. F. Teichmeyer and W. H. A. Stroehlein, 'De calculis biliariis,' Jenæ, 1742, was republished by Haller in 'Diss. ad Morb.,' vol. iii, p. 639. The authors, after having given a general description of gall-stones, relate some experiments which they made upon these concretions with heat, acids, and alkalies, and in the course of which, among other unimportant reactions, they found that "the nitric acid solution yielded a precipitate of calcareous earth on addition of Ol. Tartari per deliquium." From this they conclude that, "besides copious sulphur (combustible matters), the calculi contain earth, which serves them as basis and fundament." Hence the thesis—"*Causa* calculi *immediata* est coagulatio, qua sulphur bilis solutum ex menstruo suo secedit atque cum terra unitum solidescit" (p. 644).

In the same year was published the dissertation by L. A. Wislicen, 'Lapides bilioso-lymphatici per metastasin febris catarrhalis exorti ac per abdomen exulceratum exclusi,' Lipsiæ, 1742 (in Haller, 'Diss. ad Morb.,' vol. iii, p. 629). It relates the history of a man who, after much suffering, discharged a number of gall-stones through an aperture made by caustic on the top of an inflamed tumour which had formed in the right side, four fingers' breadth sideways from the umbilicus.

Haller ('Opuscula Pathologica,' of which an English edition appeared, entitled 'Patholog. Observations,' London, 1756, obs. 33, p. 77), after having stated that stone in the bladder was so rare at Goettingen that it had been found only in two cases out of 230 bodies dissected in the anatomical theatre, relates fourteen cases out of the same 230, in which biliary calculi were found. History 1 is that of a female who had the gall-bladder all over of a white colour, and quite empty of bile; within it were two white, chalky stones, about the size of a filbert, which under their external coat were of a deep-green colour, that terminated in yellow. "These stones had afforded nourishment to some invisible animalcules, which had gnawed angular furrows in the external cretaceous surface, besides burrows which they had made in the yellow substance within." History 2.—The subject, a woman, was jaundiced; the liver was morbid, ulcerous, and devoid of blood; in the gall-bladder were found fifteen stones. The calculus nearest to the cystic duct had a kind of beak, which went some way into that duct. History 3 is that of a man who had been melancholy mad, and whose liver was so enlarged as to be in contact with the spleen. In the gall-bladder there was a calculus nearly equal in bulk to the bladder itself. Histories 4 to 6 are ordinary cases. History 7 relates the finding of a crystalline gall-stone. History 8 is clinical, and is that of a woman who discharged at times angular gall-stones through a spontaneous ulcer in the epigastrium. History 9 is the case of a lawyer who died from gall-stone disease, with jaundice. History 10 refers to the gall-stones of oxen. "Of those taken out of the gall-bladder and its ducts I have some tubular, mucous, of the very same figure and size with the ducts, and of a deep-yellow colour. Those taken from the gall-bladder in these animals are generally lighter than the human; irregular in their shape, black, and cortical, and under their black cortex is a fissile, lucid substance." Next follow some general remarks on gall-stones in man; that they never attack young persons or children; that they are sometimes accompanied with jaundice, but for the most part without it, as had already been observed by Louis le Vasseur, 'Triumvir. Sylv.,' p. 24, and also by Morgagni. The dilatation of the ductus choledochus or cysticus, taken notice of by Cajetanus Tacconus and others, Haller says he has never observed. The calculi which were simply calcareous he never saw inflammable.

In History 13 Haller opposes the opinion of Sylvius ('Comm. Boerh.,' iii, p. 161), that the bile is secreted in and by the gall-bladder. The last History (14) is that of a woman who was dropsical and had a scirrhous liver. In the gall-bladder 141 calculi were found; three small stones were fixed in the cystic duct. The ductus choledochus was full of bile, while the gall-bladder and cystic duct contained none, which proved that the bile was secreted in the liver.

The work of Coe, 'A Treatise on Biliary Concretions,' 8vo, Lond., 1757 (a German translation was published in 1783), was the first monograph on gall-stones in which the combination of the anatomical, physical, and clinical knowledge acquired up to the middle of the last century concerning gall-stones was attempted. The preface, from which I have quoted considerable passages concerning the writings of former physicians, particularly of those who lived near to or within the author's time, exhibits learning and the reverence of a fine-feeling mind. The last twenty pages, however, of this preface, in which he gives an account of his design, are tedious, and do not contain matter of any value in the present day.

Coe next begins the body of his work with an introduction of forty-eight pages, treating of disease in general, and of its diagnosis, and insisting upon a very careful distinction between diseases which have symptoms in common. From paraphrenitis and its complications he then gradually comes to hepatitis and the various forms of colic; and then gives a preliminary description of gall-stone colic (p. 44). "Of all the pains that happen in or near the abdomen there are none which are more generally called by the name of colic than those which are occasioned by biliary calculi. The patients themselves always call this disorder a colic, and it is often so reckoned by many that undertake the cure of patients, either from too hasty a view of the case or not being acquainted with these calculous obstructions, or not able, by an attentive consideration and a nice distinction of circumstances, to find them out." He then dilates upon the frequency of gall-stones, quoting Simpson and Haller in support. The introduction ends with the relation of a case, which I have given amongst the illustrations. The first chapter (pp. 49 to 68) treats of the bile or gall.

Coe's theory of gall-stones rests upon the assumption of stagnation and inspissation (p. 63). "When bile stagnates, its grosser parts, or dregs, are very apt to coagulate and form concretions. This we see by experiments made with bile, and by its spontaneous changes when it is out of the body. And when by any means the bile is stopped or retarded, so as to stagnate long either in the gall-bladder or ducts, especially if before the stoppage it was unusually thick and viscid or abounded more than ordinarily with earthy particles, it is readily formed into biliary concretions or gall-stones of various kinds."

Coe then discusses the causes of stoppage and inspissation, mainly relying upon Hoffmann's statements. He has not seen the concretions in very young people, but relates some cases from the experience of others, which I have recorded under the chapter treating of the influence of age.

The work of Coe is, on the whole, distinguished more by its pleasant style than by the penetration of the subject or the perusal of its literature. Good and practical as it must have appeared to his time, there is little in the practice there recommended which would be tolerated or useful in our days.

In 1767 Lieutaud, 'Hist. Anat. Med.,' i, obs. 861 *et seq.*, quoted thirty-five observations in which calculi (pseudolapides biliares) were found, from various sources: Morgagni, Bonetus, 'Act. Chir. Parisiens.,' 'Diarium Eruditor.,' Heister, Imbertus, his own 'Adversaria,' Haller, Timæus, Camerarius, Coiterus, Fabr. Hildanus, Kentmann, 'Instit. Bononianæ,' Deodatus, 'Miscell. curiosis.,' Wepferus, Creterus, Fernelius, Ballonius, Helwigius, Riolanus, Cruccius, Stieberus, Mœbius; also thirty-nine observations in which calculi were a subordinate feature in cases of death from diseases having no immediate connection with the calculi. Under the chapter on obstructions of the biliary ducts there are some observations in which the obstruction was due to calculi:—Obs. 897, by Storck; 898, from 'Miscell. curiosis.'; 900 and 901, from the author's 'Adversaria;' 903, Diemerbroek; 904, 'Misc. curios.;' 905, Vesalius; 906, Cabrollius.

In the year 1771 W. White published an 'Essay on the Diseases of the Bile; on Gall-stones, &c.,' 8vo, York. He begins with an introduction extracted from Coe. Next he describes the liver and bile, and mentions the experiments of Fordyce upon healthy, Macbride upon putrid, and Sir John Pringle upon diseased, bile. What he says of diseases of the bile is mere imagination. A description of gall-stones, and a very explicit one of their symptoms, follows. On pp. 44 and 45 is repeated what Hippocrates and Sydenham say about a certain kind of colic, probably from gall-stones, of the cause of which, however, both were ignorant. Page 53 brings the author's method of cure;

later, the opinions of Baglivi, Riverius, and Sylvius, are cited. The author keeps the medicine, with which he asserts to have effected one cure, a profound secret, and thereby, as well as by the general style of his performance, assigns to himself a very inferior place in the historical literature of this subject.

Chr. H. Wilckens, 'De calculis biliariis,' 4to, Argent, 1777, relates the case of a servant girl who came to the hospital very ill; she was bled many times, and died. The gall-bladder contained three gall-stones; one was impacted in the duct. The bladder was full of gas—"vesicula fellea aëre elastico erat turgidissima qui vulnere inflicto cum strepitu exibat" (p. 4). He gives a good synopsis of the remarks of F. Hoffmann, Van Swieten, and Haller, and quotes Frank de Frankenau, 'Satyr. med.,' p. 582, as having observed a complication of twenty-three urinary calculi with twenty-two biliary ones in one and the same patient. He quotes the observation of Van Swieten, Aph. 950, in which bile left to putrefy in a glass vessel deposited calculous particles in the bottom of the vessel. The following observations are also referred to:—Scultetus ('Armament. chir.,' obs. 61) observed a pellucid gall-stone, like a crystal. Huxham ('Oper. phys. med.,' t. iii, p. 11) took black calculi, like fossil coal, out of a gall-bladder; they had glimmering particles in them. Petit ('Mém. de l'Acad. de Chir.,' tom. i, p. 186) extracted a calculus four inches long by three inches in circumference. The same also felt the calculi through the abdomen, establishing a new diagnostic point; 3646 calculi are noticed to have been found 'Act. N. C.,' v, obs. 68. Lieutaud ('Hist. Anat. Med.,' t. i, obs. 862) described siliceous-like calculi.* Hales ('Statics of Vegetables,' cap. vi, 165) found some calculi soluble in the

* This observation is not Lieutaud's own, but quoted from Bonetus.

lixivium of sal tartari. The same author (l. c., p. 167) observed that dry calculi contain air, and for this reason float when thrown upon water. Heisterus ('Ac. N. C.,' t. i, obs. 181) observed the common duct at the duodenum enlarged, so as easily to admit the little finger. The whole dissertation extends over thirty-six quarto pages, and must in every sense be pronounced an excellent performance.

In the year 1790 appeared several publications by a French physician of the name of Durande, the most noteworthy of which were entitled 'Observations sur l'éfficacité du mélange d'éther sulphurique et d'huile volatile de térébinthe dans les coliques hépatiques produites par des pierres biliaires,' 8vo, Strasburg, 1790; and 'Mém. sur les pierres biliaires,' Dijon, 1790. In these pamphlets Durande claimed to have cured many persons of gall-stone disease by a course of emollient treatment and the subsequent exhibition of the ethereal mixture in daily doses of from forty minims to one fluid drachm; the use of the mixture was continued until a pound of it had been used, when the course of treatment was terminated by the administration of some mild purgatives. The popularity of this remedy was due, in the first instance, to the anodyne effect of the ether, which in Germany had been known and used for upwards of sixty years, and had been specially recommended for the relief of gall-stone colic in the dissertation of Nitzsch. Another and, with the scientific world, much stronger claim of Durande's remedy consisted in the power, fallaciously ascribed to it, of effecting the solution of biliary calculi in the bladder and ducts.

Two years later there was published at Mayence a dissertation on gall-stones by F. P. Straub, which is noteworthy as having been written under the presidency of Sam. Theod. Soemmering, and as being, in some manner, the forerunner of a treatise on the same subject published by this latter author in the year 1795. Soemmering was for Germany what John Hunter was for this country; but in addition to the love of original observation and the assiduity required for the establishment of a useful collection, Soemmering had a great reverence for the writings of preceding inquirers, and, accordingly, we find that his treatise 'De concrementis biliariis corporis humani,' Traj. ad Moen., 1795, does not only contain the results of his numerous dissections and the descriptions of the specimens in his collection, but also a great number of references to authors of all times and nations, and an excellent recapitulation of their results and conclusions.

Shortly before Soemmering the celebrated French surgeon Petit had made the tumours of the gall-bladder which are the consequence of the obstruction of the biliary passages by gall-stones the particular object of his studies, and had come to the determination to extract biliary calculi by surgical operations, not only in cases where a fistulous opening admitted of dilatation and the subsequent introduction of instruments, but also in cases where the gall-stones in the enlarged bladder being clearly recognised by the sound and sensation they gave on percussion, it was reasonable to expect gastrotomy to be successful. Petit's paper appeared in the first volume of the 'Mém. de l'Acad. Royale de Chir.' His plan was adopted in Germany by A. G. Richter, who, in his work on practical surgery, entitled 'Anfangsgründe der Wundarzneikunst,' v, cap. 3, 1798, gave an excellent description of biliary fistulæ and their treatment, and of enlargements of the gall-bladder from calculi and their treatment by surgical operations. The essays of Petit and Richter must be carefully perused in order to see that the propositions of their authors were by no means so chimerical as subsequent writers have endeavoured to make out.

An English physician, Richard Powell, made the next addition to our knowledge concerning biliary calculi by his accurate description, in his work on 'The Bile and its Diseases,' lectures delivered before the College of Physicians, 1800, of the physical and chemical properties of the small, jet-black calculi, consisting mainly of altered colouring matter of bile. Though many authors have, during the last sixty years, questioned or denied the existence of such calculi, and were in some measure justified by an unfortunate expression of Powell, who said that the insoluble residue of these calculi was pure carbon, such calculi exactly yielding all the reactions described by Powell are by no means rare, and several specimens which have fallen under my own observation will be described under the chapter treating of these concretions.

We have next to notice the work by W. Saunders, 'A Treatise on the Structure, Economy, and Diseases of the Liver, with an inquiry into the properties and component parts of the Bile and Biliary Calculi,' which experienced four editions, the last being published at London, in octavo, in 1809.

From that time to the present day neither Germany nor England has produced any important monograph on gall-stone disease. The clinical lectures of Stokes, in the 'London Med. and Surg. Journal,' were the most practical résumé of the subject furnished by Ireland during the first half of this century. France alone has continued to show to this subject that favour which has attached to its literature the names of greatest renown in medical, surgical, or chemical history. After the excellent treatise by Buisson, 'De la Bile,' Montpellier, 1843, which gave a concise account of the knowledge regarding gall-stones which had been obtained up to that time, the Academy of Medicine judged that the time had arrived for giving further encouragement to inquiry on this subject, and in 1846 promised a prize of sixty pounds to the author of the best essay on the bile in its physiological and abnormal state, and on the treatment to be adopted when it is in a diseased condition. This prize was obtained by the essay of Fauconneau-Dufresne, the same author who already, in 1841, had published a paper on the subject in the 'Révue Médicale.' The essay, entitled, 'La Bile et ses Maladies,' was published in the 'Mémoires de l'Académie de Médecine' for 1848, the thirteenth volume of the whole series of 'Mémoires' In his preface the author says that the direction of his studies did not permit him to treat more particularly of the chemical part of the programme of the Academy. He confines himself to a relation of what he believes to be the actual knowledge obtained up to his time, without making any additions to the chemistry either of the bile or of gall-stones. The pathological part contains, however, the results of much meritorious observation. The greatest merit of this memoir is of a literary nature, although sufficient care has not been taken in the consultation and quotation of older and particularly of foreign authors.

The latest account of gall-stones is contained in the work on 'Diseases of the Liver,' by Frerichs, vol. ii, 1861. It opens with what, in the English translation, is termed an "historical account," which is historical only in this respect, that it contains almost as many errors as sentences. Next follows an account of the ingredients of gall-stones, which contains some original observations. Various engravings, dispersed over several plates of the atlas, collected on one plate in the translation, illustrate the structure of some gall-stones, and the appearances of some of their ingredients. The chapter on the mode of origin of gall-stones is not the most clear and convincing, and is, moreover, incomplete, by the omission of all reference to some important observations published during the last five years. The pathological part is concise, and illustrated by eight clinical observations. The appendix contains a number of qualitative analyses of gall-stones executed by Dr. Neukomm, of which an account will be given in a subsequent chapter.

CHAPTER II.

PHYSICAL DESCRIPTION OF GALL-STONES.

That a gall-stone is not a fortuitous concurrence of particles, but a product of a process specific and definable, may be learned from the typical nature of its composition. Its composition determines its structure; its structure permits us to draw conclusions upon its composition and the mode of its formation.

I. *Shape.* Morgagni paid great attention to the shape of gall-stones, and corrected the faulty descriptions of earlier writers. He observed the frequent occurrence of tetrahedral forms, but did not explain their formation.

Solitary calculi are round, oval, or club-shaped. The round, globular calculus has been the most moveable, and in the gall-bladder, as is evidenced by its structure, has grown by equable apposition of new matter round the whole of its surface. The oval and club-shaped forms of calculi are determined by the shape of the gall-bladder. While apposition of new matter took place all over their surface, the greater part, in the thickest layers, was deposited at the two ends.

Social calculi are always found to have made concessions of space to each other. They are flattened on several sides, a consequence, no doubt, of pressure and friction during, and in some degree after, their formation. The bodies thus formed have no stereometric outlines; they possess nothing of the regularity of crystals, axes according to cleavage are absent; but nevertheless the perfection of the cubes, prisms, octahedra, tetrahedra, and other forms met with amongst a heap of most irregular and fantastic forms, is often surprising.

When gall-stones are so fitted upon each other that the prominences of the one exactly fill the depressions of the other, they are called articulating. Frequently the articulating surfaces are almost plane, by attrition or deposition of secondary matter between them. The comparison of these articulating calculi to the bones of the wrist, which was made by Haller, is particularly true for those calculi of which one represents a capitulum and the other an acetabulum to receive the former. Fabricius Hildanus (cent. 4, obs. 44) relates a case where a gall-stone was so excavated as to receive in its hollow nearly a third of the second calculus. Bouisson (73) relates that Dubreuil possessed a spindle-shaped calculus of such a size that it had filled up the entire cavity of the gall-bladder. Its upper part exhibited an excavation, which received the lower part. Morgagni, in order to show that the articulating surfaces of gall-stones are produced by friction, describes a calculus consisting of three pieces, of which the lowest one articulated by a cavity with the middle one.

The small variety of black calculi, containing much colouring matter, have a great similarity to black pepper. Sometimes, particularly when containing much carbonate of lime, they have a warty surface, which, in the case of Hein, amounted to a surface with long projections.

These calculi Bouisson proposed to term mulberry calculi. As Walter ('Mus. Anat.') and Prochaska ('Op. min.,' t. ii, "De calculo felleo," 1800) had already employed this term for the cholesterine calculus with the warty surface and radiary arrangement of crystals, the proposition of Buisson would have created confusion, had it been acted upon. Moreover, these small, rough calculi have really no similarity to a mulberry, either in size, shape, or colour; the name was therefore not justified, and not adopted by one single writer after Buisson. Nor was the nomenclature proposed by Walter and Prochaska adopted, as it was felt that to give the name of a class of urinary calculi, which had some pretence for bearing it, to a rare biliary concretion, which had no claim for it whatever, would be creating confusion where the ordinary terms would show nothing but clear distinctions.

A rarer form of gall-stones, alluded to by Frerichs, takes the shape of flat, leaf-like bodies, with black surfaces of a metallic lustre. Another variety described by Seifert assumes the form of pale-blue, six-sided discs, of which from twenty to thirty are found together in a gall-bladder.

Calculi which were originally round or oval may, when they remain in the gall-bladder for a length of time after the specific disease of the bile by which they were produced has ceased, undergo considerable changes by secondary deposits upon their surface. The materials for these deposits are sometimes supplied by the gall-bladder, and then consist of carbonate of lime, with little else. In other instances they are supplied both by the glands of the gall-bladder and by the bile, as was the case in the calculus described by Frerichs; one half of the surface of this originally oval calculus exhibited yellow excrescences, formed by fatty matter from the bile; the other half of the surface, which, it is conjectured, lay in continued contact with the mucous membrane of the fundus of the gall-bladder, was covered with white excrescences of carbonate of lime.

There are a few cases on record of branched calculi developed in the bile-ducts, and representing casts of those canals. Glisson found in the liver of an ox tubular concretions, imitating the shape of bile-ducts, and, like them, being pervious in the interior. Similar concretions were found by Haller, as quoted on p. 39.

II. *Size.*—The size of gall-stones varies between that of a pin's head and a hen's egg. Olives, filberts, walnuts, pigeon's and hen's eggs, are favorite objects of comparison for denoting size. The following description and classification of sizes has a practical advantage.

1. Small gall-stones may be termed those which pass the ducts without giving rise to symptoms. They are frequently not observed during life. To this class also belong those somewhat larger gall-stones which pass with colics, but without injuring the passages.

2. Medium-sized gall-stones are those which pass only through very enlarged ducts, after long retention of bile, and generally through a rupture of the entrance of the duct into the duodenum, or through abnormal apertures. In the intestines they easily cause obstruction.

3. Large gall-stones are those which fill almost the whole gall-bladder, and are rarely, if ever, passed.

Generally, the size of calculi stands in an inverse ratio to their number, and the largest calculi are single ones. Buisson observed a calculus of the size of a hen's egg. Meckel ('Pathol. Anat.,' iii) has described and figured a gall-stone which was found in the gall-bladder of a dropsical person, and measured five and a half inches in length, and four and a half inches in its greatest circumference. Meersman ('Gaz. Méd.,' 1840) has described a calculus which was three inches long and one inch in thickness.

Large calculi have been found in the common duct, and have probably attained a part of their size in the place in which they were found. The manner in which large calculi, which obstructed the intestine, passed out of the ducts or bladder is not in all cases ascertained, but it must be supposed to be through openings made by rupture, ulceration, or abscess.

NOTE.—*Biliary gravel.*—Calculi, small and numerous, like grains of sand, are the characteristics of this condition. The processes which give rise to them are, no doubt, analogous to, or identical with, those which produce gall-stones. I found the biliary ducts of a man who had died with gall-stones full of a brown, sand-like matter, consisting of a mixture of cholochrome and cholesterine. The same matter surrounded the gall-stones in the gall-bladder. Thénard found in the gall-ducts of an ox a large quantity of yellow, pulverulent matter, which may be considered as an abortive gall-stone; the particles of cholochrome were not united, owing to the want of a binding material.

That biliary gravel is but a collection of small calculi, and not a disease *per se*, is made evident also by the observations of Buisson (70). He says that he attended several patients, the subjects of gall-stone disease, who before or after the passage of larger gall-stones discharged in the fæces granular, brown masses, derived from the bile.

This gravel passes the ducts without pain, and can sometimes be discovered by an attentive examination of the fæces. At post-mortem examinations it can be detected in the gall-bladder, by compressing it between two fingers and letting the membranes gradually pass between them. They are found at the bottom of a thick and turbid bile. The varieties of gravel correspond to the varieties of calculi.

Gravel of cholesterine.—When calculi of a very small size are found in very large numbers in the gall-bladder, they are sometimes termed biliary gravel. Buisson observed and described such a case. Some calculi were so small as to require a lens for the recognition of their facettes. They consisted of cholesterine, and were covered with a thin layer of colouring matter.

Gravel of cholochrome.— Granular pigment is very frequently found at post-mortem examinations. The case of Thénard and the one mentioned which occurred to myself are examples; the first, of pure pigment-gravel in cattle, the second, of pigment and cholesterine gravel, accompanying gall-stones.

Gravel of black pigment, or carbonaceous material, has the appearance of particles of jet, or common coal. Unless such gravel is found in the gall-bladder, great care is required to guard against imposture.

Fauconneau-Dufresne (' Mém. de l'Acad.,' xiii, 215) found fifteen grammes of a pulverulent, carbon-like matter in the gall-bladder of an aged female. Durand-Fardel (' Mém. sur l'atrophie de la vésicule,' obs. 4) found a great number of small, black grains, surrounded by very thick, blackish bile.

III. *Weight and specific gravity.*—The weight of gall-stones is generally very inconsiderable, and they cause, therefore, no symptoms which could be referred to pressure upon the fundus of the gall-bladder. In a few cases of very large gall-stones only has an obscure sensation of heaviness, in the region of the gall-bladder, been experienced.

The absolute weight of gall-stones compared to that of others—for example, urinary concretions of equal size—being very small, it follows that they are of low specific gravity. Meckel's large calculus, which was five and a half inches long and four and a half inches in its greatest circumference, weighed only six grains more than one ounce.

In cases in which the specific gravity of gall-stones was observed immediately on their being taken from the body, it was always found greater than that of water, and greater than that of bile. Such calculi sank in water and bile. It was, however, observed, that on drying they lost from one fifteenth to one third part in weight, and some now floated on water and bile. But when they were allowed to remain in contact with either of these fluids for some time they were seen to discharge air in small portions, and ultimately to sink to the bottom. When dry calculi were floated on water, and placed under the air-pump, the air was seen to leave them quickly and in considerable quantity, and the water being rapidly absorbed by the calculi, particularly when the pressure of the air was re-established, they sank to the bottom. On closer examination it was found that there were cavities in these calculi, which, at first filled with a fluid material derived from the bile in which they were formed, had on drying become filled with air; this had taken the place of the dried-up fluid, and buoyed them up when thrown on water, to the extent of diminishing their true specific gravity by one half.

Bonetus observed that a calculus, which when extracted from the gall-bladder weighed 18 grammes, after drying only weighed 14·5 grammes. Delens ('Thèse de M. Guilbert') found, in the month of December of the year 1809, a mammillated calculus, formed of layers, of the size of a nut, weighing 7 grammes 30 centigrammes; he examined it again in the month of May of the year 1813, and found that it had become very friable and weighed only 4 grammes.

These experiments make it intelligible why in former centuries gall-stones were reported to be so light as to float on water, and why even Gren could find the specific gravity of gall-stones of cholesterine to be 0·803. Thompson correctly determined the specific gravity of calculi containing much colouring matter at 1·08. Planta and Kekulé found the specific gravity of one gall-stone 0·789, while another, of almost the same size, taken from the same gall-bladder, showed 1·0814. The low specific gravity of the first calculus was explained by its containing a cavity filled with air.

In five lots of cholesterine calculi examined by Hein the specific gravity was 1·062, 1·053, 1·053, 1·069, 1·056. The specific gravity of a lot of calculi containing upwards of 50 per cent. of colouring matter, and nearly 7 per cent. of ash, was 1·270.

The highest specific gravity of gall-stones was found by Pelletan, in concretions which had passed through the urinary organs. It was 1·213 and 1·966.

IV. *Consistency.*—The particles of most gall-stones have little cohesion, and are easily displaced by a slight pressure. When their temperature is raised to that of the human body, cholesterine calculi can be compressed with the fingers without falling to pieces. Cholochrome calculi are at all times very frangible, and become the more so the older they get, so that at last they fall spontaneously to pieces, and are friable between two fingers. This change is to be attributed, in a certain measure, to the influence of air in the presence of moisture, which changes the composition of the cholochrome, altering its colour from light-yellowish or reddish-brown to dark brown.

Owing to the presence of bile and soluble salts, gall-stones are sometimes highly *hygroscopic;* thus, one of the samples of calculi examined by Hein contained 19 per cent. of water, which evaporated when the powder was exposed to the heat of boiling water.

Gall-stones have mostly a fatty feel, which is proper to the cholesterine, and perhaps to fatty acids and their salts; when kept in paper for some length of time, they frequently cause the appearance of greasy stains in the paper.

According to Buisson, they are bad conductors of heat, and do not become electrical by friction.

V. *Colour.*—The colour of gall-stones is very variable, and not uniform in the great majority of instances. Gall-stones of almost pure cholesterine are of a pearly white and somewhat translucent, but become of a greenish tinge by exposure to light and air. Those which have a crust of cholesterine in the state of impalpable powder appear chalk-like, and make a white mark like chalk upon a board or a slate. Cholesterine calculi offer all shades of colours, from white, through yellow, red, blue, green, to dark green, brown, and black. The calculus from the ox is uniformly yellowish-red or reddish-brown, the powder much lighter than the calculus. Many human calculi are spotted; the body of the concretion being yellow, patches of dark green, almost black pigment, are deposited upon it, so that the appearance of the abdominal aspect of the salamander is produced. Some calculi show the same arrangement of layers in their interior. Others shine, as if they were lacquered, particularly at their articulating surfaces, being polished by friction.

There are at present no certain data of the circumstances determining the colour of gall-stones beyond those afforded by their chemical composition.

All gall-stones, when kept, become darker. The cholochrome, which is a warm reddish or yellowish-brown, becomes of the colour now termed after the painter who used it to best effect, Van Dyke. It is this changeable nature of ox gall-stone which has caused first its mixture with more durable substances, and in our days its almost entire exclusion from the list of materials for water colours.

VI. *Structure.*—The structure of gall-stones was first more accurately examined by Kentmann. He was succeeded in this research by Fabricius Hildanus (cent. 4, obs. 44), Malpighi ('Opusc. pathol.'), Trew ('Comment.

litt.,' 1733), and Walter ('Anatom. Mus.,' Berlin, 1796, i, 93). This latter author took the structure of gall-stones as a basis for their classification, and distinguished striated, lamellated, and corticated calculi. The striated calculi were so called because, on section, they exhibited rays passing from the centre to the periphery, a structure which, properly, should have procured them the name of radiated calculi. They were subdivided into the transparent and opaque, and into the smooth, uneven, or crystalline and mulberry-shaped variety. The lamellated calculi consisted of concentric layers round a nucleus, and resembled on a section somewhat the structure of a horizontal section of an onion. The third class possessed a nucleus and an irregular substance surrounding it, but outermost they exhibited a well-marked cortex or crust. To this latter class Walter declared belonged the greater number of all gall-stones. Hein (Henle and Pfeufer's 'Zeitschr.,' iv, 352) divided calculi into two great classes, the simple and compound calculi. The simple or homogeneous concretions might be composed of cholesterine, pigment, or earthy matter. Of compound calculi he distinguished two varieties—first, those whose structural parts appeared uniformly mixed; and, secondly, those which were not uniformly mixed, and, besides, admitted of the distinction of a nucleus and cortex. The last author who attempted a classification of gall-stones on the basis of their structure was H. Meckel ('Microgeologie. Ueber Concremente,' edited by Billroth, Berlin, 1856, p. 85). His fantastic conception of their origin and subsequent changes led him to admit eight classes of gall-stones. The classification of Hein was adopted by Frerichs, but without the subdivisions of the second class. Frerichs, consequently, admits only two kinds of structure in gall-stones, the simple or homogeneous, and the compound one, with a nucleus, shell, and crust. The simple or homogeneous calculi have a uniform texture, and present an earthy, saponaceous, or crystalline fracture. Those with an earthy fracture consist of earthy matter or of an intimate mixture of cholesterine and pigment-lime; those of a saponaceous fracture consist of biliary resin, or its compounds with lime, or of cholesterine and soaps, while the crystalline variety consists of pure crystallized cholesterine. On the whole, these homogeneous concretions without a nucleus and shell are rare. Common is the second kind of calculi, those of a compound structure, which show a nucleus, an intermediate part, termed by Frerichs shell, and an outer layer or crust.

The nucleus.—Most calculi contain a brown or black nucleus, which can be best seen when they are divided in two halves by means of a sharp knife, with the assistance of a sudden blow. When a small quantity of this brown matter of the nucleus is scooped out and placed under the microscope, masses of dark matter, mixed with fragments of cholesterine, are seen. The dark matter, whatever its shape and diameter, becomes broken in the attempt to separate it. To examine the shape of the particles composing the nucleus, it is therefore necessary to dissolve the cholesterine by means of benzole or ether, without shaking, and then cautiously to collect the brown residue in a watch-glass, and study it with low powers of the microscope. The nucleus may be perfect and hard, or pulpy, as in the case hereafter to be related; or it may be cleft, and present flat or many-cornered cavities and crevices, in which secondary deposits of white crystals of cholesterine, of soaps, and fatty acids, appear. The cleavage of the nucleus sometimes takes place already in the gall-bladder, at other times it is the result of the drying of the pulpy matter after the gall-stone has been removed from the fluid in which it was contained. Some calculi, after drying, show a little cavity in the centre, filled with fragments of the dried-up nucleus, which not rarely, particularly in ox gall-stones, is reduced to a fine powder.

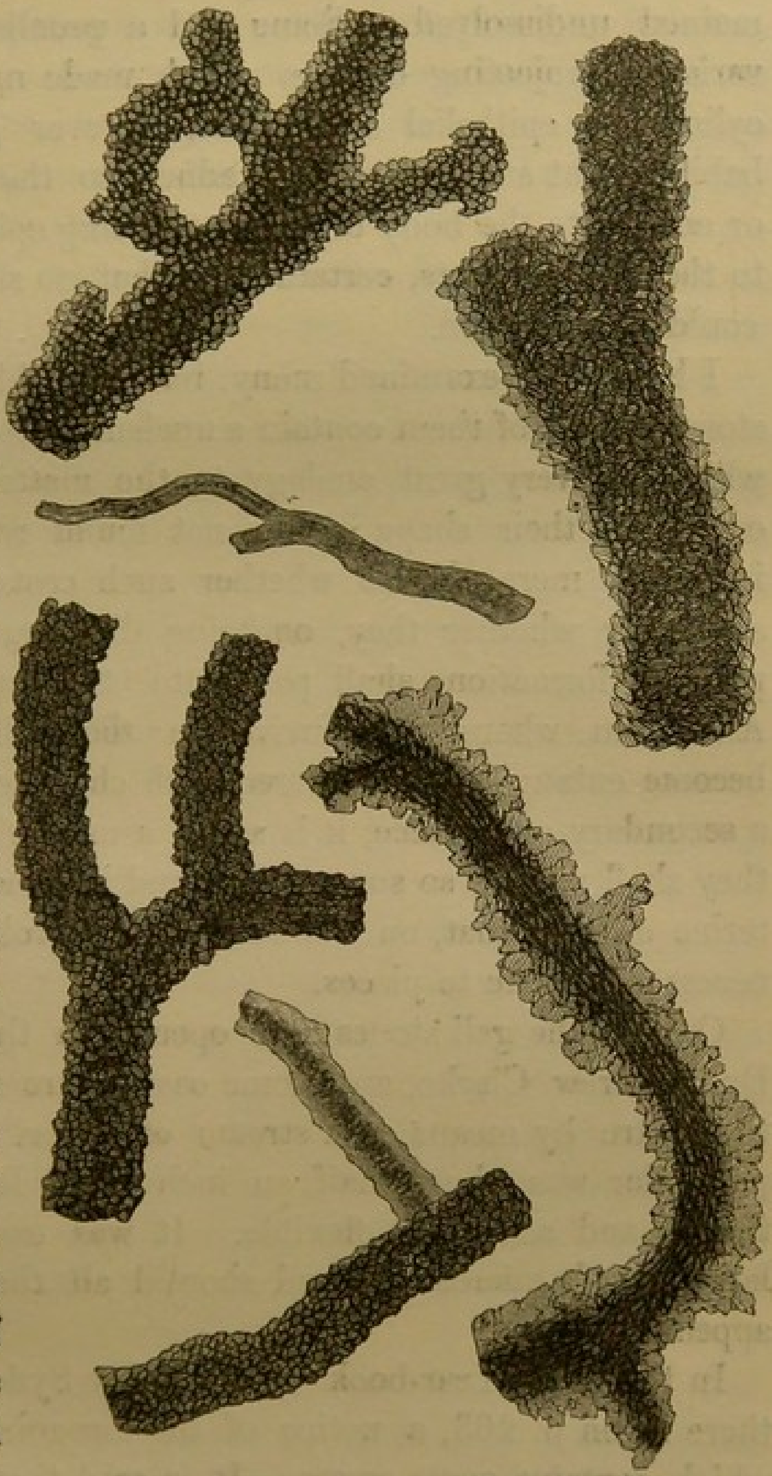
In the following case the nuclei of a number of gall-stones contained *casts of the biliary ducts.*

Sarah Paine, married, æt. 60, was admitted into St. George's Hospital on June 23rd, 1858, under the care of Dr. Pitman. She had anasarca of the lower extremities, dyspnœa, and livid countenance. She stated that she had been ill six weeks, with pain at the chest and palpitation. Once or twice she spat a little blood. There was no history of rheumatism, but the action of the heart was violent, and a murmur could be heard at the apex, with prolongation of the first sound at the base. Digitalis was given with nitric ether and acetate of potass every six hours, and she was purged with calomel and jalap. This treatment relieved the dropsy, but the breathing became more oppressed, amounting to orthopnœa. She got but little sleep, and was more harassed by cough. None of the urine could be saved for examination, but the cardiac symptoms were quite sufficient to account for the dropsy, and she had never been troubled with any diminution in the quantity of urine, pain in the loins, &c. As the breathing grew worse, a blister was applied between the shoulders ; infusion of roses with dilute mineral acids being given to check the hæmoptysis. She sank within a week from the time of her admission. The examination of the body was instituted twenty-six hours after death. Externally, the body appeared in good condition. The subarachnoid space contained a good deal of fluid, and the brain was watery. Otherwise the cranial contents were natural. There was much fluid in both pleural cavities, and extensive adhesions in the right. The upper parts of both lungs were healthy, but both contained extensive extravasations of blood at their bases. This extravasation had consolidated all the base of each lung for the space of about an inch. The heart was of large size. The edges of the mitral valve were much thickened, especially on the auricular aspect, and the orifice so contracted as only to admit the point of the forefinger. The aortic valves were also thickened, and very rigid. The ribs were much pressed in, apparently by tight lacing. The liver was (apparently) healthy, except that at its sharp edge a rounded mass, about the size of a walnut, was found, which was of a semi-solid consistence, and whitish colour, and contained the bags of numerous hydatids, attached to which the hooklets of the echinococcus were found in large numbers. The gall-bladder was large, and contained numerous gall-stones, but the duct did not seem obstructed. The spleen and supra-renal glands were healthy. The kidneys were healthy, except that there was a deep depression on the surface of the right, probably the mark of an old cyst. The abdominal aorta was extensively atheromatous. The ovaries were shrunken. The os uteri was closed by a plug of gelatinous lymph, and the cavity of the uterus contained some turbid fluid. ('St. George's Hospital Register,' 1858, No. 1623; P.-M. E., No. 177.)

On examining the bile in the gall-bladder I found it to consist of a homogeneous fluid, containing little colouring matter in solution, but a large amount of brownish-yellow granular colouring matter together with many crystals of cholesterine, were suspended in it. The bile and colouring matters dissolved in alcohol, yielding a yellow solution, which was separated from mucus and epithelium by filtration. The alcohol was distilled off, and the residue tested with sugar and sulphuric acid. But no colour-test could be obtained with the greatest care and although the test was repeated several times; there was not a trace of biliary acid in this fluid. But it contained some margaric and stearic acid, which, together with the cholesterine, crystallized from the concentrated extract.

The gall-stones were sixteen in number. On dividing the largest one into two halves, I found a large nucleus of brown, pulpy matter, which could easily be removed with the point of a knife or washed away with a brisk stream of water from a wash-bottle or so-called blow-bottle. When collected in a white china dish, the matter appeared to be composed of thread-like fibres, of different diameters, some a quarter of an inch long; some shorter pieces were one-sixteenth of an inch in thickness. All were cylindrical, as if moulded in tubes; many had branches, others were divided dichotomically. The thinnest portions had a diffuse, broom-like end, as if the matter had not had time or quality to solidify in the tubular form, or as if it had solidified in a bag-like enlargement of the cylinder in which the rest of the cast was moulded. The matter composing these productions was granular, without a trace of crystallization of any kind; was purely yellow in the thinnest branches, but became the darker brown the thicker the forms grew. All further description becomes at once unnecessary by the faithful representations of the more striking portions represented on the two plates annexed to this volume, which have been designed from the microscope by Mr. Lens Aldous and printed in colour by Messrs. M. and N. Hanhart. The subjoined woodcut, originally published in the 'Brit. Med. Journ.' of Nov. 19, 1859, represents on a reduced scale some of the casts depicted on the plates. Some forty or fifty medical gentlemen, to whom I had an opportunity of submitting both the specimens and their drawings, have borne witness to the accuracy of the representation. All of them agreed with me that these peculiar formations can be nothing else but casts of the biliary ducts.

They were so fragile that the mere weight of a thin glass cover, as used for microscopical preparations, was sufficient to crush the thinner ones. When shaken in the watch-glasses in which I kept them, moistened with glycerine, the mere friction of one against the other would damage and disintegrate the most characteristic features. About half the number of gall-stones, and among them some large-sized ones, although containing a good brown nucleus, yet did not admit of the separation of characteristic casts, although among the débris I could distinguish fragments of casts with ease and certainty.



Casts of Biliary Ducts from Nuclei of Gall-Stones. Mag. 80 diam.

The material of the casts was not chemically homogeneous. Alcohol extracted a yellow portion, another portion remained undissolved. Some had a peculiarly ragged or variably projecting outline, which made me examine for cylindrical epithelial cells; but, however great the probability that such cells might adhere to the circumference or enter into the body of the casts, being epithelium proper to the biliary ducts, certain it is that no such formations could be identified.

I have since examined many, but only old and dry, gall-stones; most of them contain a nucleus of colouring matter which has very great analogy to the matter forming the casts, but their shape I have not found repeated. It is, indeed, a mere chance whether such casts shall be preserved or whether they, on being discharged from their place of formation, shall pass into the intestinal canal. And even where they arrive in the gall-bladder, and become entangled and covered with cholesterine, evidently a secondary occurrence, it is again a mere chance whether they shall not be so surrounded and interlaced by cholesterine crystals that, on the stone being broken, they must necessarily come to pieces.

One of the gall-stones was opened in the presence of Dr. Andrew Clarke, and some casts were washed out of the centre by means of a stream of water. One cast in particular was about half an inch long, like a piece of thread, and somewhat flexible. It was examined with a large Ross's microscope, and showed all the characteristic appearances.

In the first 'Year-book' of the New Sydenham Society there is, on p. 263, a notice of the foregoing observation which contains some errors. It is said that I discovered the casts in one gall-stone, whereas they were present in eight. It is next stated that the casts appeared, *from the* *figures*, to have been covered over with crystals of cholesterine. If the woodcut of *one* large cast, by some angular bodies on its outline, might admit of such a supposition, it is certainly supported neither by the appearance of five out of the six woodcuts, nor by a close scrutiny of the original drawings as represented on the plates, nor by the appearance of the casts themselves.

In some rare cases foreign bodies have been found to constitute the nuclei of gall-stones. In a calculus which came from the common duct of a female, aged 68 years, in whose dilated biliary ducts thirty ascarides were found, a dried-up ascaris was met with by Lobstein; an engraving of this calculus was given by Lobstein in his 'Pathological Anatomy,' and a copy of it has been published in the work of Buisson. This latter author, guided by the observation of Lobstein, examined a very soft gall-stone, of the size of an almond, which had been taken from the hepatic duct of an ox, and found it to harbour as a nucleus a recognisable fragment of a fluke. A gall-stone weighing four ounces, preserved in the collection at Göttingen, and known to have been developed in an abscess of the liver, produced by perforating ulcer of the stomach, was found by Fuchs and Frerichs to contain a plum-stone in its centre. Nauche ('Lancette Française' du 10 Septembre, 1835) found in a contracted and otherwise empty gall-bladder a biliary calculous incrustation, of the size of a small filbert, formed round a needle which was two centimètres in length, oxidized, and with its point penetrated the wall of the gall-bladder.

The position of the nucleus is mostly central, but varies the more the greater the irregularity of shape of the calculus. Some calculi contain two nuclei, and in a few as many as four and five nuclei have been observed. Such calculi are evidently the result of the firm concretion of several originally separate calculi.

The body of the calculus.—The part of the calculus which is situated between the nucleus and the crust, and which by some authors has been termed the middle part, or striated portion—by Frerichs, strangely enough " the shell—" makes up the bulk of the calculus, and should, therefore, be termed " the body." In this part cholesterine mostly prevails, and by the radiary arrangement of its crystals produces a star-like appearance. In large calculi the lines starting from the centre are sometimes undulating. In some calculi a concentric arrangement of layers is added to the radiary arrangement of crystals, producing, with the aid of a great variety of colours, a pleasing appearance. Most commonly, however, the body consists of an irregular mixture of cholesterine, with colouring matter and products of decomposition of the bile. In ox gall-stones the body consists principally of cholochrome, arranged in concentric spheres ; between the single layers small deposits of cholate of lime and other matters can be distinguished. A rare description of cholesterine calculus, which is almost free from cholochrome, possesses only a very small nucleus, and is rarely covered with a crust ; almost its entire body is made up of radiating crystals of cholesterine ; these crystals sometimes appear on the surface, with their points producing a mammillated appearance, or with their sides producing crystalline ridges ; in one case I have even observed rhombic crystals of cholesterine, which, unlike the common plates, possessed considerable body, and a smallest diameter of about one twelfth of an inch.

The crust or rind is present in the majority of gall-stones which have remained for some time in the cavities in which they were formed. It is distinct from the body, and not rarely can be separated from it like a shell. It consists of concentric layers, of variable thickness, which may adhere firmly to each other or separate with ease. It may be uniformly thick round the entire calculus, or more developed in one place and less in another. Its outer surface is not unfrequently covered with warty excrescences of carbonate of lime, colouring or other matter, particularly when only one gall-stone is present in a gall-bladder. When several calculi are together, the rind may be polished in some, rough and corroded in other, parts. In some cases it is covered with a white, pulverulent layer of cholesterine, which has the appearance of chalk, but does not contain any. In other cases the crust is smooth and white, with patches of cholesterine adhering to it. Indeed, the varieties of the external appearances and colours of the crust are so great as to baffle every attempt at description.

CHAPTER III.

CHEMISTRY OF GALL-STONES.

Historical Notes on the Chemical Analysis of Human Gall-stones.

MANY authors before the time of Haller subjected gall-stones to chemical proceedings. Amongst them were Boerhaave, Vallisnerius, Hales, Straehlinius (Stroehlein), Knoll, Tacconius, Moseder, Wislicen, Bezold, Hoffmann, Coe, Maclurg, Vriss, and Spielmann. Of the results of these authors Haller ('Element. Physiol.,' lib. xxiii, lect. iii, § 13 et § 19, tom. vi, pp. 571—575) gave an abstract. The partial solubility of the calculi in spirit, oil of turpentine, potash, and nitric acid, was then well known, but none of the ingredients were separated or distinguished. The calculi were also subjected to dry distillation, and an oil was obtained, which when freed from empyreumatic matter exhaled a grateful odour, and in combination with mineral acids formed crystals. The account of Haller may appropriately be considered to close the first period of the analysis of gall-stones.

The second period comprises analyses instituted and related by the following authors:

Scopoli, in Crell's 'Beiträge zu den chemischen Annalen,' Band iii. Conradi, B. G. F. præsid. Ch. G. Gruner, 'Dissertatio sistens Experimenta nonnulla cum Calculis

Vesiculæ felleæ humanæ instituta,' Jenæ, 1775, 4. In this dissertation cholesterine is for the first time described as isolated and distinguished. Delius, 'De Cholelithis, observationes et experimenta, etc.,' cum tabulis, Erlangæ, 1782, 4, pp. 13 to 15. This author communicated an abstract of his researches in a letter to Crell (see his 'Neueste Entdeckungen,' viii, 100). "The examination of gall-stones (of which I have treated in a separate essay) has made me inclined to look upon them, not as calculi, but as a resin of animal mixture, or, if you will, to call it concretely, an animal sulphur or pitch. Water, acids, alkalies, do not touch it; on the contrary, it is, however, best dissolved by a very good liquor anodynus (mixture of alcohol and ether), further by tincture of antimony, spirit of wine, soap, and the yelk of egg. . . When gall-stones were dissolved in the mentioned menstrua they yielded peculiar glistening, little leaves, which appeared similar to the sedative salt; and to me it appeared as if the fatty matter with which raw borax comes to us (boracic acid) was the cause thereof."

Notices of the foregoing researches, and some trifling original additions, are to be found in Macquer's 'Chemical Dictionary,' particularly the German edition, by D. S. G. Leonhardi, tom. v, 1782, pp. 238—241; Percival, in S. Priestley's 'Experiments and Observations on certain kinds of Air,' German edition, Leipzig, 1779, ii, 378; and in Hermbstaedt's 'Beiträge zur Natur und Arzneiwissenschaft,' Th. iii. Of the experiments of this latter author there is a short notice in Crell's 'Chem. Ann.,' 1787, i, 154:—"I decomposed a crystalline gall-stone which only weighed fifty grains. According to the small experiments which it permitted, it possessed chalky earth, sugar-acid (oxalic acid), and resinous parts." The following authors require to be next mentioned:—Gren, 'Handbuch der

Chemie,' tom. ii, § 1536, and in Crell's 'Beiträge zu den Chem. Annalen,' Stück i, 1789; also part iv, Stück i, 1792. Wadsberg and Acrel, 'De Cholelithis per abscessum ruptum egredientibus casus et experimenta, quæ præside T. A. Acrel publico subjecit examini A. M. Wadsberg,' Upsaliæ, 1788, 4, cum figur., pp. 15 et seq. G. S. Dietrich, 'Dissert. continens duas observationes rariores circa calculos in corpore humano inventos,' Halæ, 1788, cum figuris, pp. 62 usque 69. Hahnemann (Crell's 'Chem. Ann.,' 1788, ii, 269), "Something on the Bile and Biliary Calculi." His experiments on the bile of a person who had been shot were repetitions of others previously instituted upon ox bile. None of the experiments, which consisted in the addition of various reagents, led to any notable or definite result. The mucus he terms gluten, and finds that it is precipitated by acetic acid and spirit of wine. When this precipitate by spirits is dry, it is said to resemble much the gall-stones of brandy-drinkers. He says that his experiments had therapeutic intentions. Some crude conclusions terminate the empty article. Goldwiz, 'Versuche über die Pathologie der Galle,' Bamberg, 1789, 8vo, denied Haller's statement that gall-stones contained (or yielded) 648 times their bulk of air. S. C. Titius, præsid. F. S. Kreysig, 'Dissert. analyseos calculorum et humanorum et animalium chemicæ specimen primum,' Lipsiæ, 1789, 4to. Of the important paper of Fourcroy, "Chemical Examination of the foliated and crystalline substance contained in Gall-stones, and of the nature of the cystic crystallized concretions," 'Ann. de Chim.' (1789), iii, 242, the following is an abstract:

When about 1770 Poulletier de la Salle undertook to investigate the nature of gall-stones, and, following up some indications of Sénac, to determine their solubility in alcohol, he found that, while the alcohol dissolved the greater part, there remained a foliated, brilliant mass of scales, much resembling boracic acid. Collecting them on the filter, he, after drying, retained but a small quantity of matter, which he placed on a piece of charcoal, where it evaporated as smoke or vapour. He then made attempts to collect gall-stones; and though he continued his endeavours for fifteen years, amongst all kinds of professional persons, particularly those who made dissections in hospitals, yet he could never collect more than a few grains, which were insufficient for making the desired examination. The discovery of this crystalline matter was simply announced in the 'Dictionnaire de Chimie,' but Macquer gave no further information about the nature of this singular substance. Poulletier, however, gave some further information to Fourcroy, which this chemist recorded in his paper, under four heads, as follows:

1. The crystalline matter appears to be much more soluble in warm than in cold alcohol; the warm liquid passes the filtering paper quite clear, but the matter separates so quickly that its discoverer believed it to pass through the paper at the same time as the alcohol.

2. The matter appears to vary in quantity in different human biliary calculi, although it is constantly present in all these concretions.

3. The proportion contained in these calculi is very inconsiderable, and scarcely a few grains are obtained from a gros (seventy-two grains) of biliary calculi.

4. The gall-stones of quadrupeds, and particularly those of the ox, which the butchers collect with great care for the use of painters, are soluble in alcohol, but contain no crystalline matters.

Fourcroy repeated these experiments in 1785 upon the contents of two full gall-bladders. The calculi were polished, with four faces (tetrahedra?), gray outside, and of a brownish-green colour inside. Two ounces of the powder of these calculi required two pounds of alcohol, at a gentle heat, to be dissolved, and even then some darker-brown and harder parts refused to dissolve. The fluid was filtered hot; it passed clear, of a yellow-greenish colour; on cooling, it quickly deposited a large quantity of brilliant plates, resembling boracic acid. It was consequently proved that the substance had been dissolved in the hot alcohol and been precipitated by the cooling of the fluid.

Fourcroy then describes correctly the properties of this substance (cholesterine) when subjected to higher temperatures, its fusion, its distillation, its insolubility, and fusion in boiling water; but he ends in stating that the caustic alkalies dissolve it, and form a true soap. His preparation was probably only a mixture.

Fourcroy then describes a kind of stone, to which he says Haller drew first attention in 1789—the large, roundish calculus, in concentric layers, gray outside, or white with a dark centre. He also claims for M. Vicq-d'Azyr ('Hist. de la Soc. royale de Méd.,' année 1779, page 218) the merit of having the first distinguished these calculi from the common ones, and given several engravings.

He next constructs a theory of gall-stones which is based upon the assumption of the presence in the liver of an excess of this crystalline matter, and upon the assumption that the rest of the constituents of gall-stones is nothing but inspissated bile. He confounds the crystalline matter with a kind of fat which he found in a piece of human liver which had been exposed to the air for ten years. The human liver had given him a white crystalline distillate in the neck of the retort (which, no doubt, consisted of leucine); the crystalline matter from the calculi had also evaporated on being heated, and as the distilled substances resembled each other, the fallacy was completed.

Fourcroy ('Ann. Chim.,' vii, 190, 1790) instituted a comparison between the crystalline matter of gall-stones, the fatty matter derived from the remains of human bodies which had been interred for some time in the Cimetière des Innocents, afterwards termed adipocere, and spermaceti.

One part of the crystalline matter from gall-stones required for solution nineteen parts of alcohol showing thirty-eight degrees of strength at the temperature of 60° Réaumur. At the temperature of 10° to 12° R. only one twenty-fifth part of the substance remained dissolved, the other twenty-four parts became precipitated.

Of the kind of wax from human cadavers, one part of alcohol at 60° R. dissolved nearly an equal weight, and, on cooling, one fourth or one fifth part remained in solution. The substance could be saponified with much greater facility than either the matter from gall-stones or spermaceti.

The same quantity of alcohol at the temperature of 10° R. dissolved only six grains of spermaceti at 60° R. In the same alcohol, on cooling to 10° R., hardly any substance remained dissolved.

The fusibility of the three substances was found as follows:

Waxy matter from cadavers	fused	at	28° to 30° R.
Spermaceti	do.	do.	32° to 35° R.

Gall-stone matter not yet softened at 90° R., viz., above the boiling point of water.

Schlippe, an apothecary at Mayence, made some experiments on gall-stones, which were published in the dissertation of Straub (praesid. Soemmering). Some notices on this subject also occur in the work of W. Saunders, 'On the Liver,' London, 1793, cap. viii. In the sixteenth volume of the 'Ann. de Chim.,' of the year 1793, Fourcroy gave an abstract of his article on calculi in the 'Diction. encyclopédique.' Notwithstanding great efforts and extended correspondence, and the assistance of the Soc. de Méd., he had only obtained a few concretions, not sufficient to complete his intended inquiries. He alludes to hepatic calculi, with the remark that they had not yet been examined by any chemist, and would probably be analogous in composition to the calculi in the gall-bladder.

The results of the experiments of Dietrich, Gren, Titius, Fourcroy, and Schlippe, were summarised by Soemmering ('De concrementis biliariis,' 1795, p. 40 et sequentes) as follows:

Experiments of Dietrich.—The powdered calculi did not dissolve in water, even on heating. They burned with the odour of wax. They dissolved in concentrated oil of vitriol, giving out a sulphurous odour, and leaving a resinous residue. Subjected to dry distillation in a retort, in a sand-bath, they first emitted inflammable air, next nebulous vapours, then a yellowish, ammoniacal vapour passed into the receiver, together with a thick, empyreumatic matter, which settled to the bottom of the vessel. There remained a glistening, light charcoal in the retort, which could only with difficulty be incinerated. After incineration, however, it left an earth, which, dissolved in nitric acid, gave a precipitate with sugar acid (oxalic), and which, therefore, he believes to be phosphate of lime. Ten grains of the concrement digested at a gentle heat, with half an ounce of strongest spirit, yielded scaly, silvery, shining crystals, which were greatly admired. The spirit was scarcely coloured yellow. Even when augmented in quantity, the spirit retained hardly anything in solution; it therefore effected only a change in the shape of the particles composing the calculus. The author, therefore, failed to observe the solubility of cholesterine in boiling alcohol, and argues that the salt, which Poulletier de la

Salle and Delius had obtained from gall-stones by means of spirit of wine, had been the concrement itself, which, according to his estimate, contained in 100 parts 85 parts of waxy and 15 parts of glutinous matter. The author also states that the concrements dissolved perfectly in expressed oil of almonds.

Gren found that gall-stones dissolved in vitriolic naphtha or sulphuric ether, but not in spirit of wine nor in salts. He estimated the ingredients to be in 100 parts, 85 parts of waxy and 15 parts of lymphatic matter.

Titius was the first to observe the volatility of cholesterine. He took cubical, black calculi, containing a yellowish crystalline nucleus, and put them into a chemical pneumatic apparatus (retort). At first, on the open fire, they became fluid, next a vapour and nebulous air passed into the cylindrical vessel, and in various places of the tubular part of the retort a waxy matter adhered, which, when rinsed into the cylinder (receiver) by means of water, was recognised as "true yellow wax." When the heat was increased the entire mass was dissolved, boiled, and emitted much fixed and a much larger quantity of inflammable air. The residue, calcined in a crucible, left earthy matter, containing phosphoric acid and lime.

In the year 1806 Thénard read his second memoir on bile before the Academy of Sciences. The second part of this memoir was devoted to a consideration of the concretions found in the gall-bladder of the ox and of man. Of the gall-stones of the ox he said that they were generally considered to have originated in an inspissation of bile, although they hardly contained 1 per cent. of it; and that the error could only be explained by assuming it to be a rash conclusion from the bitter taste of those calculi, unsupported by any attempt at a chemical proceeding.

He next states that the gall-stones of the ox possess the following properties:—After having been extracted with water to remove the small quantity of bile between its particles, they are without taste or odour; their colour is, from the centre to the surface, always yellow, and this yellow is even pure and rich enough to be sought after by some painters, although it is not durable. If, after having been dried as far as possible, gall-stones are exposed to heat, they are not changed or decomposed by heat until the retort begins to get red hot. They then begin to blister in some places, and evolve white vapours, which consist of water, oil, gaseous matter, carbonate of ammonium; and, ultimately, leave a somewhat dense charcoal, which by complete incineration leaves one sixteenth of a white substance consisting exclusively of phosphate of lime.

By exposure to light and air their colour is gradually changed into brown, and this change has even been perceived to take place in the paintings in which they have been employed.

Although hot or cold water, which has been allowed to digest the stones, assumes a yellow colour, yet on evaporation it does not yield one three-hundreth part of its weight of residue. Alcohol and oils behave in a similar manner. The caustic alkalies dissolve the calculi, though with difficulty; the solution is yellowish, and is precipitated in green flakes by hydrochloric acid. Boiling hydrochloric acid dissolves little of the calculi, and colours them green.

The matter which forms the gall-stones of oxen is, therefore, uniform, and possesses properties which are peculiar to it. It is exactly of the same nature as the yellow matter which is found in the bile of oxen and of man.

Of human gall-stones Thénard remarks that they had been examined much more frequently than those of oxen. He mentions the trials of Poulletier and Fourcroy. He then states that Dupuytren put 300 gall-stones at his disposal, of which some had been formed in the gall-bladder, others in the gall-ducts, and a number in the liver itself. A small number consisted of white, glistening and crystalline scales, consisting entirely of adipocere ; many, which were formed of yellow scales, contained 88 to 94 parts of adipocere, and from 12 to 6 parts of the colouring matter. Some were coloured green externally by some bile; inside, however, they were yellow, similar to the former ones; several were partly covered by a blackish-brown crust, in which there was but little adipocere; internally they were, again, as the former variety ; sometimes the black substance occupied the centre, and the yellow, scaly one was deposited externally ; two or three were blackish-brown throughout their entire substance, without any glistening or crystalline point, and almost destitute of adipocere. It was to be remarked that all calculi, with the exception of the white ones, contained traces of bile, which could be separated by water.

Thénard had also analysed two calculi which had been taken from the intestinal canal; both contained much adipocere in gray and yellow scales. The one had been given to him by a physician of the name of Geoffroy, and the other by a M. Canuette, who had himself taken it from the rectum of a woman of forty years of age, whose death it had caused by the complete obstruction of this bowel.

Thénard then says that he coincides with Fourcroy in this, that there are human gall-stones consisting entirely of adipocere, and that all of them contain a certain quantity of this substance; at the same time he remarks that almost all gall-stones contain also a certain quantity of a matter which gives them the colour, and which may be yellow or blackish-brown, and that some consist entirely of this substance.

Of the colouring matter he says, further, that while yellow it does not appear to be different from that which forms the gall-stones of oxen; when it becomes of a blackish-brown colour it is mainly the same, though changed in such a manner as to indicate a prevalence of carbon. At least this is the most probable, as gall-stones of the ox show a similar change, become brown, and then yield more carbon and less water, oil, &c., than in the ordinary condition.

Bostock ('Nicholson's Journal,' No. 54, xiii, 476) also observed that the substance which accompanied adipocere in gall-stones was not, as Fourcroy ('Syst.,' 10, 59) himself had at first believed, inspissated bile, but something else, because, after the removal of the adipocere by alcohol, it could not be dissolved in any fluid.

Thénard's theory of the formation of calculi in the gall-bladder of man and of oxen.

On examining the inside of the gall-stones of oxen, we find them composed of homogeneous, frequently very numerous layers, in the centre of which a small, round body takes the place of nucleus, which nucleus is always of the same nature as the layers themselves; these calculi are, therefore, the products of depositions occurring at different times. But as it is evident from their properties that they only consist of that ingredient of bile which has been described under the name of yellow matter, we are obliged to conclude—1. That there are circumstances under which this yellow matter can be precipitated from bile. 2. That there are no circumstances under which the bile could yield different substances. We know that the yellow matter is of itself insoluble, and is maintained in solution in the bile solely by means of the soda, to which, however, it has no great affinity. If it bė remembered that the bile contains only little soda, of which, moreover, the greatest part is combined with the picromel and oil; if attention be, moreover, given to the circumstance that the quantity of yellow matter contained in bile is subject to variation; one can easily conceive *that its proportion to the quantity of soda may sometimes be excessive, and that it may, consequently, be deposited.* If it is further considered that the bile contains, besides the yellow matter, only one more which is not soluble in water, namely, the resin, which, if it were precipitated, would contribute to the formation of gall-stones, but that, on the one hand, this resin is so intimately combined with the picromel and the soda that it cannot be separated from them even by the strongest acids, and that, on the other hand, the two latter substances are present in bile in such proportions that the resin is quite insufficient to saturate them, no doubt upon the correctness of the above conclusions can possibly remain. The formation of gall-stones in the ox is, therefore, easily to be explained.

The formation of gall-stones in man, however, exhibits some uncertainty; for these concretions most frequently contain two ingredients, the yellow matter and adipocere. The deposition of the yellow matter in human bile is easily to be understood, because it is contained in it in the same form and under the same conditions as in ox bile, only in smaller quantities; but how is the deposition of adipocere to be comprehended? If it were an ingredient of human bile, all difficulties would be removed; but none of it is found in the bile, not even in that bile in which many gall-stones have been found. *It must, therefore, be assumed either that the adipocere forms in the liver, and is deposited immediately, or almost immediately, after its formation; or that the resin contained in human bile can, under certain circumstances, transform into adipocere.* In either of these two possible cases it cannot be doubted that the nuclei of all calculi originate in the bile-ducts, and are afterwards carried by the bile either into the intestines or—and that most frequently—into the gall-bladder, where they continue to become larger. This is proved by the large number of calculi found in the gall-bladder, and by those which are met with in the bile-ducts.

The above extract from Thénard's memoir is evidence that, while he had some shrewd ideas about the immediate cause of the deposition of cholochrome and the possible presence of biliary resin (which he overlooked in his analysis, owing to limited quantities of material and ignorance of its properties), he, nevertheless, had no conception of the real nature of the process in bile which produces these calculi. His hypothesis of the formation of calculi in man is still further removed from what we are obliged to admit in the present day, and is, moreover, disfigured by the error that adipocere was not a normal ingredient of human bile. The details of his disquisition contain, however, a great advance upon what was known before him.

He adds some reflections on the statements concerning the solution of calculi in the gall-bladder, and believes them to be very unreliable. How can it be believed, he exclaims, that calculi should disappear from the gall-bladder of oxen in spring, when they feed upon new grass? This might be admitted for calculi consisting of inspissated bile, and even then it would not be evident why they should not dissolve in the water of the bile in winter as well as summer (it would not be evident, he might have added, why and how they should or could have formed at all). But now, after it is found that they consist of a matter which is insoluble in water, and resists for a long time the influence even of the strongest reagents, this opinion, if not laid aside altogether, may, at least, be put amongst the number of those which have little foundation. For it can only be supported by the observations of the butchers, according to which they are said not to be found during the summer, but during the winter. But is it possible to place much confidence in such observations? I must more than doubt it, (1) because the butchers, in the majority of instances, at least, do not examine the gall-bladders in summer; (2) because, according to their own admission, these calculi are also very rare during the winter; and (3) because I have succeeded in finding two calculi during summer time in two different gall-bladders. It appears to me, therefore, that all that can reasonably be asserted in this respect consists in this, that in summer such calculi are less frequently formed than during winter.

Thénard concludes his memoir with some remarks on the alleged solution of calculi in the human gall-bladder by means of a mixture of oil of turpentine and ether. This solution he believes not to be more probable than that of calculi in the gall-bladder of oxen fed upon fresh herbs, because at a temperature of 32° R. the ether must separate from the oil of turpentine and evaporate; the mixture, moreover, could only be taken in moderate doses, and even when taken in large doses no part of it could get into the gall-bladder, or at least only so small a quantity that its solvent power could not be taken into account. Thénard admits the observations of Guyton, which were to the effect that oil of turpentine caused repeatedly all stones in the gall-bladder to disappear. But he asks whether this could not have been effected by favouring the passage of the calculi to the intestines. In the two cases related by Guyton the disease and treatment had resulted in the expulsion of calculi by the anus. A similar result was by many believed to occur in oxen; the juices of the young herbs were not supposed to dissolve the calculi, but by a copious flow of bile to effect or favour their expulsion.

J. F. John ('Chem. Unters.', vol. iii, n. xiii, p. 46, 1811, and Schweigger, 11, 1, 1814) asserted his belief that all the concretions found in human gall-bladders consisted of adipocere and insoluble yellow biliary matter, and that only in a limited number of concretions slight modifications were effected by the supervention of small quantities of other ingredients. This he found to be the case in more than twenty kinds of gall-stones of very different colours. At the auction of the collections of Reil (the celebrated physician and author of the fever doctrine) he had an opportunity of acquiring gall-stones of a perfectly white colour, the body of which consisted only of adipocere; but the brown nucleus, which was enclosed in the white external layers, contained all the more yellow matter.

Older Analytical Proceedings.

Berzelius recommended to powder the calculus, and to treat the powder with water, in order to dissolve any bile which might be present. The residue is next put into boiling alcohol, which extracts cholesterine, and after filtration while in the boiling hot state deposits it on cooling. The residue on the filter is completely exhausted with alcohol, and then treated with a weak solution of caustic potassa, in which colouring matter, mucus, and any albumen which may happen to be present, are dissolved. The alkaline solution is neutralized by acetic acid, and colouring matter and mucus are thereby precipitated. By means of concentrated acetic acid the colouring matter may be extracted from this precipitate. Albumen, if present, remains in the neutral solution of acetate of potassa, where it can be discovered by ferrocyanuret of potassium.

In this analytical proceeding no attention is paid to the biliary matters which are not soluble in water, none to the inorganic ingredients; the colouring matter is obtained in an altered state.

Garot, who made most of the analyses of Fauconneau-Dufresne, extracts the calculi with ether to remove cholesterine, afterwards with turpentine. The insoluble residue is placed upon a filter and washed with ether, when nothing but reddish mucus is said to remain on the filter.

In this analysis the oil of turpentine is employed to remove colouring matter; if it dissolves some, it has, on the other hand, an oxydizing effect upon what remains, and is, therefore, to be avoided in exact analyses. Cholesterine also dissolves in turpentine in the cold, but it requires fifteen times the amount of time which it would require to dissolve in ether. Heat expedites the solution.

Simon extracts the dried and powdered calculi with water, in order to remove undecomposed bile and other soluble matters. The residue is completely dried and treated with hot ether, which takes up cholesterine and fat. The ethereal extract, after evaporation of the ether dissolved in boiling alcohol, on cooling deposits cholesterine, and on evaporation leaves the fats. The residue which had been extracted with ether is now boiled with alcohol, which dissolves biliary resin, when present. What remains may contain colouring matter, to be extracted by carbonate of ammonia, and mucus, to be dissolved in dilute caustic potassa; there are left the insoluble inorganic salts.

In this analysis the whole of the fatty acids combined with earths are not obtained; if the residue from the extraction of ether is treated with acid before being boiled with alcohol, fatty acid and resin become mixed, and are difficult to separate.

In the ordinary analysis of gall-stones, which began with the extraction of the powder by means of caustic potassa—a process mainly directed to the purification of cholesterine—choloidic (and cholic) acid remained with the cholochloine produced, from which it could afterwards be scarcely separated. When the analysis of gall-stones had, however, for its principal object the preparation of cholophæine, the spirituous mother-liquor of cholesterine was not thought of sufficient importance to deserve further scrutiny; and even if it had been granted, it is possible that the fatty salts dissolved by the boiling spirit (which, in the analysis with benzole, remain undissolved, and are subsequently decomposed with acid and extracted with ether and water) would have made the separation of the choloidic acid a matter of considerable difficulty.

Heintz ('Poggend.', 84, 106) analysed the brown residue which remains when human gall-stones are extracted with boiling alcohol. He found that it effervesced strongly when treated with hydrochloric acid. He then incinerated the matter, and found the ashes to consist of a trace of iron, a small quantity of sulphate, and large quantities of phosphate and carbonate of lime. Magnesia was present only in very small quantity. He then dried two different portions of the same brown substance at 120° C. in the air-bath, incinerated the one portion at a temperature at which the carbonate of lime could not pass into the caustic state, and determined the amount of carbonic acid by means of the loss which the substance suffered when treated with acid in a suitable apparatus; this loss of carbonic acid amounted to 9·91 per cent. Another quantity of the brown residue was placed in the same apparatus without having been heated, and the carbonic acid contained in it was also determined by the loss after treatment with acid. It amounted to 9·41 per cent. From these experiments it was clear that the greater part of the lime was combined with carbonic acid, and not directly with the colouring matter, and it was even doubtful whether the difference between the two figures was due to errors of analysis or to differences in the nature of the combination.

For this reason Heintz repeated his experiment upon a new portion of residue from human gall-stones. The ashes of the residue were of the same composition as in the first case, and contained traces of iron and small quantities of sulphate, but large quantities of phosphate and carbonate of lime. The proportion of ash, however, to the amount of colouring matter was much smaller in this case than in the former one. For in the first analysis the amount of ash obtained had been between 50 and 60 per cent., while in the last analysis only 25·6 per cent. of ash were obtained. Of the brown matter used in the second analysis which had not been burnt, one hundred parts yielded 3·19 per cent. of carbonic acid, but other hundred parts, after combustion, showed a loss of 4·57 per cent. of carbonic acid. Such a difference cannot be ascribed to faults of method, and it compels us to assume that a part of the cholochrome contained in the brown colouring matter of gall-stones is really combined with lime, which, although in the first examination it could be only one twentieth, in the latter analysis must have amounted to one third, of the entire amount of lime.

Analysis of Human Gall-Stones.

For the analysis of the common cholesterine concretion from man, the following process will be found suitable.

The powder of the calculi is gradually thrown into hot benzole, contained in a flask, placed on a sand-bath. The cholesterine and biliary matters are dissolved, while cholochrome, earthy phosphates, earthy salts of fatty acids, and any other ingredients, remain suspended and unchanged. Solution and residue are separated by filtration. The matter on the filter is washed with repeated quantities of benzole, lastly with cold alcohol, and dried. It then presents itself as a brown powder, which is very delicate to the touch, imparting an almost velvety feel. Treated on the filter with absolute ether containing hydrochloric acid, it yields fatty acids to the ether, which, on distillation of the ether from the filtrate, are deposited in a granular and crystalline form. If the residue on the filter is next treated with water, phosphate and hydrochlorate of lime and magnesia are extracted, and, on evaporation of the solution and incineration of the residue, remain as a white deposit, sometimes coloured blue by copper. The colouring matter, extracted with ether and hydrochloric acid and water, is free from fatty matter, but retains some earths, which can only be obtained by treating it with warm, dilute hydrochloric acid, or by dissolving it in carbonate of alkali, when the earthy and other insoluble inorganic and organic matters remain behind. They are then incinerated, and the ashes added to the earths extracted by acid and water.

From the original benzole solution cholesterine is best obtained by evaporating the solvent and treating the residue with boiling spirit of wine. On cooling, the cholesterine, which before had been greenish, crystallizes in the usual glistening white plates, while the solution retains the brownish-green coloured biliary matters. On evaporation, a small quantity of a mixture of cholesterine and fat is deposited. That and the rest of the alcohol being removed, there remains a brown, resinous mass, insoluble in water, soluble in alcohol, and soluble in caustic potassa; an excess of caustic ley added to the solution causes the separation of a resinous salt, which floats on the top of the caustic fluid. From the solution in potassa it is precipitated by hydrochloric acid. It combines with lime and baryta, forming insoluble compounds, and is therefore choloidic acid, though brown and impure, and perhaps, as suggested by the analysis of ox gall-stones, mixed with some cholic and cholonic acid. It yields a small quantity of matter to boiling water; but the nature of this extract could not be determined by crystallization, as was the case in the analogous extract from ox gall-stones.

The mineral ingredients of human gall-stones obtained in the manner above described were, in most of my researches, further analysed as follows:—On being treated with hydrochloric acid the matter dissolved with strong effervescence, yielding a golden-yellow solution, only a small, white *deposit* of sulphate of lime and alumina remaining undissolved. After dilution, the solution was greenish-yellow. It was filtered, and hydrothion passed through the solution. A black precipitate fell down, being sulphide of *copper*, as it formed a blue solution with excess of ammonia added to its solution in aqua regia. The filtrate was saturated with ammonia, an excess causing a precipitate, which, on addition of sulphide of ammonium, became black. This precipitate was removed by filtration, and the filtrate treated with carbonate of ammonia. This threw down a copious precipitate of carbonate of *lime*, which had not been in combination with phosphoric acid, but probably with fatty acid and cholochrome. The filtrate from the lime deposited some *magnesia*, after addition of phosphate of soda, in the usual way.

The sulphide of ammonium precipitate was dissolved in warm, dilute hydrochloric acid, over-saturated with carbonate of soda, and the alkaline fluid made acid again by acetic acid. A precipitate which remained was *phosphate of iron*. This being removed, chloride of iron was added until a drop of the fluid filtered produced a blue stain on paper moistened with solution of ferrocyanide of potassium. The precipitate, which contained all the *phosphoric acid* in the solution, was removed by filtration. The filtrate was over-saturated with ammonia to remove excess of iron. The precipitate, after filtration and boiling with excess of nitric acid and peroxide of lead, gave distinct evidence of the presence of a small quantity of *manganese*. The ammoniacal solution, after addition of ammonia and carbonate of ammonia, gave a precipitate of carbonate of *lime*, containing the lime which had been in combination with phosphoric acid. The filtrate, after evaporation to a smaller bulk, was treated with ammonia and phosphate of soda. After some days it had deposited a small quantity of ammonio-phosphate of *magnesia*, containing the magnesia which in the gall-stones had been in combination with phosphoric acid.

General Consideration of the Ingredients of Gall-stones.

CHOLESTERINE.

Cholesterine, like the colouring matter of bile, seems to be an ingredient of this fluid destined for ultimate excretion from the body. It is secreted from the blood by the liver-cells, and kept in solution by the biliary salts. When the acids contained in these salts undergo a certain kind of decomposition, cholesterine is deposited, mostly in a crystalline condition, and may then form calculi, either by itself, or with the assistance of cholochrome and biliary acids.

A residue, if not a product, of many morbid processes in the tissues, and one of the compounds resulting from the putrefaction of fibrine, this alcohol (for such it has been proved to be by the researches of Berthelot) is one of the few stationary traces of disease which, owing to characteristic appearances, may easily be diagnosed with the naked eye or the microscope.

Its solubility in ether, benzole, and boiling alcohol, its power of crystallizing from the latter solution in an almost pure state, its insolubility in acids, alkalies, and water, afford the means for its separation from other substances and the determination of its quantity.

When a solution of cholesterine and cholochrome in chloroform is allowed to evaporate spontaneously, the former is deposited in needle-shaped crystals, which are uniformly tinged yellow, red, or brown, by the colouring matter; scarcely any cholochrome is deposited in the granular form under these circumstances. This solubility of cholesterine in chloroform makes it absolutely necessary that, in any analysis of gall-stones in which it is intended to extract cholochrome by chloroform, the whole of the cholesterine should previously be removed by the proper application of all necessary solvents.

In gall-stones cholesterine is mostly present in its crystalline form. Frerichs says, however, that it is sometimes found amorphous and intimately mixed with other matters, such as fatty and saponaceous substances and pigment. It is rarely, if ever, present in the pigment calculus from the ox.

The pellucid crystalline variety of gall-stones consist almost entirely of pure cholesterine, and sometimes do not contain as much as 1 per cent. of other matters. In the most common kind of gall-stones, however, the amount of cholesterine varies generally between 80 and 90 per cent.

CHOLOCHROME.

The word *cholochrome* is intended to designate colouring matter of bile and all its varieties. For the brown colouring matter I retain the name *cholophæine,* for the green variety I adopt the name of *cholochloine.*

The older names of cholepyrrhine, biliphæine, and bilifulvine, may be considered as synonymous with cholophæine. Biliverdine and cholechlorine are synonyms of cholochloine.

Cholophæine seems to be a mixed form of colouring matter secreted by the liver. It occurs in gall-stones in a free state and in combination. In its free state it makes up the greater part of the bulk of ox gall-stones; it is deposited in casts of the biliary ducts found in the centre of human gall-stones, and also occurs in the nuclei and layers of these latter in an amorphous state; a certain part of it contained in gall-stones is always combined with lime or with carbonate of lime. Cholochloine, in combination with bases, is present in the darker variety of human gall-stones, giving them a green and sometimes an almost black colour. In the free state it is soluble in alcohol, and may be isolated thereby.

Analyses and composition.—Since the first attempts of Berzelius, about 1812, to determine the properties of the colouring matter of bile, several analyses have been instituted with the particular object of ascertaining its chemical or elementary composition. Those of Scherer (1843), Hein (1847), Heintz (1854), and Städeler (1861), were the most methodical, although none of them have led to final results. The elementary analyses of Scherer and Hein were performed upon specimens of cholochrome which, to conclude from the process adopted for their preparation, must have contained impurities and inorganic matter. The analyses of Heintz, on the contrary, were executed upon materials apparently homogeneous, and certainly free from inorganic substances. But the analyses of cholophæine, the brown modification of cholochrome, lead to a formula which is very ill-supported by the formula of the only metamorphosis to which, at that period, cholophæine could be subjected. Four elementary analyses, agreeing with each other, led to the empirical formula $C_{31}H_{18}N_2O_9$ for cholophæine; but one analysis of cholochloine, the green colouring matter hitherto termed biliverdine, obtained from the brown by oxidation, led Heintz to the formula $C_{16}H_9NO_5$. The improbability of the suggestion that cholophæine, in order to pass into cholochloine, should take up only half an equivalent of oxygen, Heintz met by assuming the formula of cholophæine to be $C_{32}H_{18}N_2O_9$, and by further assuming that this body took up one equivalent of oxygen, and then split up into two equivalents of cholochloine.

I have repeated the analysis of cholophæine upon materials prepared in accordance with the precedent of Heintz. In some of them I have obtained figures which are very near to those of Heintz, the hydrogen in most cases keeping steadily near 6 per cent.; but the carbon varied between 60 and 62 per cent., or to the same extent to which the first analyses of Heintz differed from his check calculation. But when I came to analyse cholophæine obtained from ox bile directly (the former specimens having been prepared from gall-stones), I obtained totally different results, the carbon rising to 66, the hydrogen to 10 and 11 per cent.

In none of the specimens analysed by me was there any trace of iron; I can, therefore, fully confirm the statement of Heintz, that iron is not an elementary ingredient of cholochrome. Hence it follows that cholochrome has no immediately apparent connection with the colouring matter of blood.

An elementary analysis by Städeler of cholepyrrhine, purified by repeated crystallization from boiling and washing with cold chloroform, yielded results from which the formula $C_{18}H_9NO_4$ was calculated.

	Calculated.		Found.
18 equivalents of carbon =	108	66·26	66·52
9 „ hydrogen =	9	5·52	6·00
1 „ nitrogen =	14	8·59	8·70
4 „ oxygen =	32	19·63	18·78
	163	100·00	100·00

The analyses which Scherer ('Ann. Pharm.,' liii, 377) made upon specimens of cholochrome from icteric urine gave results very similar to those obtained by Städeler. The analyses of Heintz, however, give, as we have seen, far different results, which, as they agree well among each other, might lead to the belief that this amorphous biliphæine of Heintz, the formula of which is nearly $C_{16}H_9NO_6$, is a body distinct from the crystallized cholepyrrhine of Frerichs and Städeler.

Cholepyrrhine, according to the formula of Städeler, contains two equivalents of water less than tyrosine.

Methods of obtaining cholochrome.—It may be extracted from ox bile, ox gall-stones, and human gall-stones. Ox bile yields about twenty grains of cholochloine per gallon, but they are hardly to be obtained pure. Gall-stones from the ox are the richest source of cholochrome. Human gall-stones, although not of rare occurrence, are not easily obtained for analysis, as the curators of anatomical museums do not like to part with any specimen that can be catalogued.

From ox bile I first endeavoured to obtain cholochrome by the process of Berzelius. The solution of dried bile in absolute alcohol is mixed with chloride of barium. The green precipitate thereby produced is placed upon a filter, washed with alcohol and water, and, yet moist, treated with hydrochloric acid. Biliverdine was to remain on the filter. But I found that the acid does not extract all the baryta; that the process by which, according to Berzelius, fatty acids are to be removed, also removes much colouring matter, and further, that what ultimately remains adheres to the paper like a resinous varnish, and cannot be isolated. This closely agrees with the experience of Heintz.

I then made use of another process. I allowed large bottles full of bile, well stoppered, to stand for the period of two years and one year respectively. A modified decomposition thereby ensued, which consisted mainly in the dissolution of the compound acids and the separation of some simple acids from their bases by the supervention of a new acid, the product of the putrefactive process. Among the substances precipitated by this latter agent was a great part of the cholochrome contained in the bile. To extract this the precipitate, after decantation of the port-wine coloured bile, was put into a calico bag, and washed with water. The process was tedious; filtration ultimately ceased, and all matters soluble in water were not entirely removed. The residue was, therefore, boiled repeatedly with alcohol, and washed on the filter with large quantities of this agent. It removed cholic and choloidic acid, and any cholate left over, also fats and fatty acids. There remained cholochrome mixed with the mucus, from which it had to be extracted by carbonate of soda. Hydrochloric acid precipitated a beautifully green substance from this alkaline solution, being somewhat impure cholochloine.

From human gall-stones and ox gall-stones I have prepared cholochrome by the process of Heintz, which consists in extracting the fine powder of these concretions by boiling alcohol, ether, and water, next by hydrochloric acid, and then dissolving the residue in a solution of carbonate of soda, the air being excluded by a complicated apparatus filled with hydrogen and carbonic acid. Cholophæine thus prepared, which, like that of Heintz, had an olive-green tint mixed with the brown, was perfectly free from ash on combustion in a platinum boat in a current of oxygen.

The colouring matter from ox gall-stones was treated with chloroform in an exhausting apparatus, with a long, narrow tube. The chloroform, after passing through a column of colouring matter fifteen inches in height, arrived in the reservoir as a reddish-brown liquid. When the extraction had been continued for about a week, the chloroform of the extract was distilled off, and the concentrated solution left to spontaneous evaporation. A granular substance was deposited, which yielded to boiling absolute alcohol a greenish-brown matter, and became of a most beautiful red colour, resembling cinnabar or red oxide of mercury. When dry, it had the sweet, musk-like odour of a healthy cow. Viewed under the microscope, it appeared mostly amorphous; but when a concentrated solution in chloroform was allowed to evaporate slowly under a little glass cover, crystals were formed in great numbers, being needles and rhombic plates. The powder was insoluble in water, little soluble in boiling absolute alcohol, sparingly soluble in ether, easily soluble in chloroform, a little more soluble in boiling than in cold chloroform. It was soluble in dilute solutions of caustic and carbonated alkalies and in an alcoholic solution of caustic potassa. When treated with concentrated sulphuric acid, it dissolved with a yellow colour, and green flakes separated on the addition of water. Nitric acid imparted a deep-crimson colour to the powder, dissolving a part, which changed from red to blue, violet, and lastly crimson. This change of colour was particularly beautiful on a thin layer of colouring matter, produced by allowing a very dilute chloroform solution to evaporate in a china dish. Such a layer, like a stain of the same solution on the skin, was of a bright-yellow colour.

This red substance is, evidently, the original form of biliary colouring matter, and a chemically pure body. I shall hereafter speak of it as the red or original form of cholochrome or *cholerythrine*.

Metamorphoses of cholochrome.—Under the influence of oxidizing agents cholophæine is easily transformed into the green modification termed cholochloine. By the agency of nitrous acid gas cholochrome is transformed into an oxyacid, free from nitrogen, which I will name cholochromic acid. By treatment with nitric acid this body is further decomposed, yielding a substance little soluble in water and crystalline, and an uncrystallizable acid, which gives a crystallized salt with ammonia.

Chlorine transforms cholophæine, first, into cholochloine; the brown is transformed into the green modification. If the action of the chlorine is continued, a moment ensues when the mass is red, but after that it becomes white, and is now chlorocholic acid, insoluble in water and soluble in, and crystallizable from, boiling alcohol.

Cholochromic acid.—Cholophæine from human gall-stones was suspended in water in a high, cylindrical vessel, which was again placed in a beaker, to prevent any loss by frothing which might occur. Nitrous acid gas, well cooled, was now passed through the mixture; after a short time the fluid began to effervesce, then to froth, a thick lather rising in the cylinder and overflowing into the provisional beaker. When the violence of the reaction had lessened, the fluids were reunited, and the passing of nitrous acid gas was continued until the reaction had ceased. The fluid was still turbid, but the brown granules of cholophæine which had been suspended in it were now changed into red flakes.

The mixture was now put into a stoppered bottle and shaken with repeated portions of ether, which assumed a dark ruby-red colour, the fluid below becoming transparent and yellowish. Extraction completed, the ether was distilled off; it left a pink, syrupy residue, being a new acid—cholochromic acid—which exhibited the following properties:

It did not crystallize when evaporated in the water-bath and dried over sulphuric acid for twenty-four hours.

It easily dissolved in chloroform, and on evaporation of the solvent in a current of coal-gas, and on standing for some days in the flask filled with this gas, a crystallization ensued in the syrup, and two forms of matter became distinguishable by the microscope—(1) Flat (clino?) rhombic octahedra, of a dark-red colour, imitating, by their resemblance to rhombic plates, their colour and their dark shadows, the appearances of the substance described as hæmatoidine. The larger crystals were clear in the centre, and transmitted light. (2) Circular or globular masses of needles, in radiary arrangement, of a very delicate appearance. These crystallized matters could not be isolated from the syrup or amorphous portion of matter surrounding the crystals.

The acid was almost insoluble in cold water, hardly imparting to it any coloration by contact with it.

It was easily soluble in spirit of wine, forming a portwine coloured solution, of a strongly acid reaction, and yielding precipitates with metallic salts. Thus, a watery solution of acetate of lead produced a copious red precipitate, almost insoluble in boiling water. Nitrate of silver yielded a copious pink precipitate. On addition of an excess of ammonia to the alcoholic solution it assumed a deep-red colour, and on evaporation red flakes remained, which were again soluble in water.

Cholochromic acid differs from hæmatodine by its solubility in alcohol and by crystallizing in (clino?) rhombic octahedra, not rhombic plates. Rotten bile, and bile treated by the proceeding of Berzelius for obtaining cholochrome have both a dark-pink colour, and chloroform extracts from the former some coloured acid.

Compounds of cholochrome.—Cholophæine and lime (*pigment lime*).—This compound was first noticed by Bramson, and made by him the nucleus of a theory of gall-stones. It is found in most gall-stones of man, in the form of granules and irregular masses, of the colour of cholophæine, mixed with cholesterine and the other matters. Frerichs found it partly deposited in the form of distinct layers between the other laminæ of the calculi.

This compound is insoluble in water, alcohol, ether, and chloroform, somewhat soluble in boiling hydrochloric acid, and deposited from this solution on evaporation of the acid; it is, however, also decomposed by this acid, inasmuch as from a mixture of this compound with hydrochloric acid pure cholophæine is extracted by chloroform, the lime remaining in solution. Pigment lime is soluble in boiling diluted solutions of alkalies.

The compounds of cholophæine with magnesia, oxide of iron, oxide of copper, manganese, zinc, alumina, and other bases occurring in gall-stones, show a similar behaviour towards hydrochloric acid alone and hydrochloric acid with chloroform.

Cholochloine and lime.—Cholochloine occurs in very small quantities in gall-stones, giving them a green tinge. It is not soluble in the alcohol which removes cholesterine and other matters, and is therefore combined, probably, with lime. The compound has, however, not been isolated, either mechanically or chemically.

Changes of cholophæine in gall-stones.—When gall-stones are preserved for a length of time the colouring matters contained in them gradually undergo a change, which is indicated by a transformation of the light yellowish-brown colour into a dark brown, almost black one. This change sometimes occurs within the body. In other cases gall-stones are found in which the colouring matter appears to have been changed from its original character before its concretion. Such gall-stones are dark, and contain a colouring matter, insoluble in chloroform, even with the assistance of hydrochloric acid, but somewhat soluble in alcoholic solutions of caustic alkalies. This latter solution has a light-yellow colour, and with coloured nitric acid yields the ordinary reaction for cholochrome.

Frerichs sometimes observed a brown material, which partially dissolved by boiling in a watery solution of potash; the solution, however, presented neither the reaction of bile-pigment nor of the biliary acids; brown flakes were deposited from it on the addition of acids.

There is little doubt that these substances are derivates of cholophæine whenever they contain nitrogen, which is mostly the case; when they are free from nitrogen they may be products of a decomposition of cholic acid, similar to that which it undergoes when its solution in water is left to spontaneous evaporation. A brown matter is deposited, together with the crystals of pure acid. Choloidic acid yields similar brown and black products of decomposition. The black pigment described by Powell, and said to consist of pure carbon, has been observed by Buisson and Bernard in a case which I have given at length. Jet-black calculi have an appearance very much resembling a piece of shining coal, the colouring matter they contain, however, being very nearly of the ordinary composition and behaviour. Some colouring matter which I collected from a large quantity of human bile was boiled with alcohol, collected on a filter, and washed with much alcohol, and then allowed to dry. After some time it presented a hard cake, which, on fracture, presented black, shining surfaces.

BILIARY ACIDS, THEIR DERIVATES AND SALTS.

Gall-stones from man contain but very small quantities of biliary salts, which remain in the alcoholic solution from which cholesterine has crystallized. Among them glykocholate and cholate of lime have been recognised. Ox gall-stones contain a larger quantity of biliary salts. The extract by boiling water on evaporation leaves a glutinous substance, from the solution of which, in water, sulphuric acid precipitates a resinous mixture of acids, containing probably glykocholic, cholonic, cholic, and choloidic acids. The alcoholic extract of gall-stones deposits on cooling white needles of cholate of lime, mixed with cholic acid. Cholic and choloidic acids remain in solution.

1. *Glykocholate of lime* was found by Frerichs in a human gall-stone. When recrystallized from spirit it consisted of small, glistening, crystalline masses, resembling leucine. He also obtained the same form of crystals from the gall-stone of an ox.

2. *Cholate of lime.*—In gall-stones from oxen cholate of lime, can be recognised in distinct, white layers, interposed between the brown layers of cholochrome. Under the microscope these layers appear composed of irregular masses of needles. The same white deposits of cholate of lime occur in putrid ox bile, partly floating on the top of the fluid, partly deposited against the walls of the bottle. When recrystallized from boiling alcohol, the needles of cholate become much larger.

3. *Cholic acid* in its free state is obtained from the alcoholic extract of ox gall-stones, together with the lime-salt, and another portion remains in solution with choloidic acid. From the resinous mass which remains when the alcohol is evaporated, free cholic acid can be extracted by prolonged boiling with water. This watery solution on spontaneous evaporation, deposits groups of splendid needles of cholic acid.

4. *Choloidic acid.*—Both human and ox gall-stones yield a resinous, brown, biliary acid, insoluble in water, soluble in spirit, uncrystallizable, and precipitated by lime-salts from its spirituous solution.

FATTY ACIDS AND THEIR SALTS.

In some gall-stones from the ox free fatty acids are said by Frerichs to have been found in considerable quantity. Crystallized from spirit, they consisted of glistening, white plates, and resembled stearic acid. I have never met with free fatty acids either in human or ox gall-stones, and in the latter I have not found any salts of the fatty acids. But in human gall-stones I have mostly met with a considerable quantity of fatty acids combined with lime. These salts were insoluble in boiling alcohol, and remained with the colouring matter, from which they were extracted by a mixture of a little nitric acid with ether. When isolated, the acids gave an emulsion on boiling with a solution of phosphate of soda, and thus manifested themselves as *palmitic* and *stearic acid.*

URIC ACID.

Stoeckhardt (‘Diss. de Cholelithis,’ Lipsiæ, 1832) drew attention to the presence of some uric acid in gall-stones. The value of these researches is, however, very limited, as there existed at that time no proper method for analysing gall-stones.

Marchand subsequently (‘Journ. f. pract. Chem.’, 1839, 37), in a paper treating of the distribution of cholesterine, described a calculus which he claimed as biliary, and which consisted principally of uric acid. It is most probable that this calculus was urinary, and had been mistaken for a biliary calculus.

In the case of Pelletan biliary calculi were voided by the urinary passages, and contained a small quantity of uric acid. The presence even of a larger quantity of uric acid in a calculus which has resided for a longer or shorter period in the urinary passages could be understood, though a uric-acid deposit upon a biliary calculus is far less probable than a phosphatic one. In such a case, however, the nucleus must be so distinct from the crust, both in physical construction and chemical composition, that there can be no doubt about the origin of either.

NEW ORGANIC SUBSTANCE IN OX GALL-STONES.

From the hydrochloric-acid extract of ox gall-stones, from which zinc had been precipitated by sulphuretted hydrogen, ether extracted an amorphous body mixed with some chloride of ammonium. The substance was yellowish, easily soluble in water, easily soluble in nitric acid, and changed by this agent on boiling under evolution of gas and peculiar smelling products into a glutinous substance insoluble in water, easily soluble in alcohol. Its watery solution was not precipitated by acetate of zinc nor by sulphate of copper, precipitated yellow by nitrate of prot-oxide of mercury; it was little soluble in cold, somewhat more soluble in boiling, alcohol; it was easily soluble in caustic ammonia and in caustic potassa, and in this solution did not discolour some basic acetate of lead on boiling. On platinum foil it became soft, then dried with crepitation, swelled up, exhaling thick fumes smelling like burned animal matter, and without taking fire was consumed, leaving a bulky, black charcoal, which was only burned with difficulty.

EPITHELIUM, MUCUS, ALBUMEN.

The nuclei of gall-stones are reported by some authors to contain epithelium, the shrivelled cylindrical cells of which can be distinguished under the microscope after all soluble matters have been removed.

Mucus or albumen I have never found in any gall-stones. In one of the ox gall-stones examined by Frerichs was found a nitrogenous substance, presenting the characters of albumen.

WATER.

Some calculi contain much water in certain cavities in their interior, or distributed throughout their substance. In one of the analyses to be given lower down, it amounts to 48 per cent. of the weight of the entire fresh calculus. A calculus observed by Chevreul when extracted from the gall-bladder weighed 10 grammes 12 centigrammes, but after drying it only weighed 4 grammes and 91 centigrammes. Bonet mentions a calculus which, by drying, lost three and a half parts out of eighteen. Delens weighed a fresh calculus, of the size of a nut, in December, 1809, and found it 7 grammes 30 centigrammes. In May, 1813, it had become very friable, and weighed only 4 grammes. (Thèse of M. Guilbert.)

MINERAL ACIDS.

1. *Silicic acid*, or silica, was observed in a human gall-stone by Pleischl; in another one, analysed by Bley, its quantity amounted to one half per cent.

2. *Phosphoric acid* is mostly present in combination with lime and magnesia, sometimes with iron.

3. *Sulphuric acid* occurs in combination with lime. *Hydro-sulphuric acid*, or sulphuretted hydrogen, has been repeatedly observed in the analysis of ox gall-stones. Its evolution is due to the decomposition of some unknown sulphide.

4. *Carbonic acid* occurs mostly in combination with lime.

5. *Chlorine* is present in ox gall-stones, as chloride of sodium. On distilling the water extract of ox gall-stones with sulphuric acid, I obtained a quantity of hydrochloric acid, which, treated with baryta water, yielded fine crystals of chloride of barium.

EARTHS AND ALKALIES.

1. *Alumina* was first observed in a human gall-stone by Bibra. I found it in the hydrochloric-acid extract from ox gall-stones.

2. *Lime* occurs in almost all gall-stones, in combination either with mineral or with organic acids. In the form of carbonate it constitutes the greater part of the bulk of a peculiar kind of small biliary calculi. It sometimes forms a crust round a cholesterine calculus, or a layer in the interior of the calculus, and can be distinguished under the microscope by its crystalline form and its chemical reactions. Sulphate and phosphate of lime, and the combinations of lime with cholochrome and cholic acid, are never-failing ingredients of gall-stones.

3. *Magnesia* is present in gall-stones in the form of phosphate, perhaps also in other forms analogous to the compounds of lime. Its quantity is, however, much smaller than that of lime, so that, when single gall-stones are taken for analysis, it is mostly overlooked.

4. *Soda,* in the form of chloride and phosphate and sulphate, or combined with biliary acid, has been found in small quantities.

5. *Potassa* in combination with an organic acid I found in a pellucid cholesterine calculus.

6. *Ammonia* is present in the hydrochloric-acid extracts of ox gall-stones; it is probably a product of the decomposition of nitrogenized matters in the gall-bladder.

METALS AND THEIR OXIDES.

1. *Iron* is contained in almost all gall-stones, and is found in the hydrochloric-acid extract of the colouring matter. Already Margraaf ('Opusc. chym.', tom. ii, p. 64) observed in the gall-stone of an ox, after he had calcined and treated it with spirit of vitriol, and the alkali prepared for making Prussian blue, some slight marks of a mixture of iron. Maclurg ('Experiments upon the Human Bile,' 1772, p. 58), who quotes this experiment of Margraaf, adds:—"But it appears, from his manner of expressing himself, that the urinary calculus, the bones of sheep and the human skull, gave yet more evident tokens of their containing iron. We cannot suppose, therefore, that the iron had any relation to the colouring matter of the bile."

2. *Manganese* is found in ox gall-stones, more rarely in those from man.

3. *Copper.*—Since it is proved by many researches that copper is almost constantly present in the liver of man and animals, its presence in gall-stones ceases to appear as an anomaly, and cannot any longer be imputed to carelessness in working with copper or brass utensils.

Since Bertozzi (Polli's 'Annali di Chimica,' Milan, Juglio, 1845, p. 32), who was the first to announce the presence of this metal in gall-stones, it has been found by many other inquirers, more particularly by Heller, who, in his 'Archiv,' ii, 228, published a paper on the subject. Buisson (p. 84) confirms Bertozzi's statement, that it is found particularly in very dark stones. In some such calculi he found the quantity of copper to amount to 0·1 per cent. I have myself found small quantities of copper accompanying the earthy salts extracted from human gall-stones by the process indicated in the paragraph which treats of their analysis. The copper was, probably, combined with cholochrome, and not with cholic or choloidic acid; for while these two acids and their salts were soluble in benzole and spirit of wine, and had been removed thereby, the copper compound was not soluble in these reagents, and remained with the other insoluble compounds until decomposed by an acid.

4. *Mercury.*—*Gall-stones containing mercury* have been observed by Frerichs (2, 533). They were mulberry-shaped concretions, of the size of peas. Their surface was of a dirty grass-green. In the furrows between the single tubercles there was here and there deposited an amorphous, yellowish-brown matter. When broken, they showed a thin but hard shell, surrounding a loose, dark, yellowish-green matter, in which there were dispersed white metallic globules. These globules easily fell out of the matter in which they were deposited, and, fusing together, formed large globules; on close examination, they were found to consist of metallic mercury. The powdered concretion yielded to ether a small quantity of a yellowish, smeary fat, in which no cholesterine could be found.

Spirit dissolved some yellowish alkali salt of a biliary acid. The residue, when treated with hydrochloric acid, evolved carbonic acid, and immediately after this yielded some cholepyrrhine to chloroform; after that, amorphous, green colouring matter to spirit. The hydrochloric-acid solution contained principally lime, small quantities of phosphates of earths, and traces of iron.

The blackish-brown residue which was left after this treatment dissolved almost completely in dilute caustic soda; the brown solution was precipitated in flakes by acids; the sparing precipitate gave no reactions either for biliary acids or biliary colouring matter.

Lacarterie ('Gaz. de Santé,' 15 Avril, 1827) has described a cholesterine gall-stone of the size of a plum, the nucleus of which, after fusion by means of heat, exhibited numerous globules of mercury. The patient from whom it came had been treated by inunction of mercurial ointment.

Beigel ('Wien. Mediz. Wochenschrift,' Nr. 15, 1856) found in a brown gall-stone globules of metallic mercury, visible by means of a lens.

5. *Zinc* I found in considerable quantity in ox gall-stones. It was contained in the hydrochloric-acid extract, and, after repeated evaporation of the acid, was precipitated from the solution by sulphuretted hydrogen.

Classification of Gall-stones.

First Series.—Pellucid or pure cholesterine calculi.

Second Series.—Mixed calculi, with prevalence of cholesterine.

Third Series.—Calculi with prevalence of cholochrome.

Fourth Series.—Calculi with prevalence of modified cholochrome.

Fifth Series.—Gall-stones with prevalence of bile acids.

Sixth Series.—Gall-stones with prevalence of fatty acids.

Seventh Series.—Gall-stones with prevalence of carbonate of lime.

Special Analyses of Gall-stones.

FIRST SERIES.—*Pellucid or pure Cholesterine Calculi.*

1. A flat, oval calculus, covered with crystals and warty projections, and transparent in many places, was presented to me by Mr. Silas Palmer, of Newbury. When first removed from the gall-bladder, some twenty years ago, it was perfectly diaphanous, and retained its clearness for

some years. Divided in two halves, it exhibited itself as consisting throughout of crystallized cholesterine. There was a radiary appearance; some crystals, however, appeared with their flat sides on the section, showing that the cholesterine was, as usual, crystallized in plates. The centre was a mere point, in which the particles lay less closely arranged; under the microscope, it exhibited a somewhat yellowish colour, but no granular colouring matter could be distinguished. What may be described as the nucleus was a minute cavity, filled with small tufts of cholesterine crystals. Viewed either with the naked eye or the microscope, the substance of the calculus appeared to consist of pure cholesterine, and nothing but a dingy hue of a ring at equal distances from the centre and the circumference denoted the presence of a gray-coloured matter.

The weight of the calculus was thirty grains. Of these 14·6 grains were taken for analysis. This piece of the calculus dissolved easily in boiling benzole; during this process yellow flakes made their appearance, some of which floated detached, others became adherent to the bottom of the glass. A large flake looked very much like mucus, and had the shape of the half of the calculus, all cholesterine being, however, dissolved out. The greenish-yellow benzole solution of cholesterine was filtered; filter and residue were washed with benzole, until all matters soluble in this agent had been removed. There remained on the filter, and fixed to the bottom of the glass vessel used for extraction, a very small quantity of matter, some of a white, some of a brown colour. Of this some was soluble in cold and boiling spirit of 56 over-proof strength, imparting to it a yellow colour. After evaporation of the spirit the quantity of matter amounted to 0·1 grain; 100 parts of calculus, therefore, contained 0·68 per cent. of this matter. It was insoluble in water, soluble in caustic potash, and yielded the reaction for bile-acids with sulphuric acid and sugar. Colouring matter and what may be supposed to be some mucus weighed 0·03 grain and amounted consequently to 0·2 per cent. of the calculus. It yielded the red reaction with nitric acid, and after exposure to heat left a residue, which, after solution in acetic acid, yielded the reaction of lime when treated with oxalate of ammonia.

The alcohol from which cholesterine had crystallized on three successive concentrations was evaporated, and the residue boiled with hydrochloric acid and water. A resinous matter separated, and after filtration and drying weighed 0·53 grain. A small quantity of fatty acid, which caused greasy stains in the filter, was not taken into account. The 0·53 grain of resinous matter yielded nothing to boiling caustic potassa that could be afterwards precipitated by acid, and did consequently contain only traces of fatty acid; it consisted, probably, of altered or amorphous cholesterine. The *hydrochloric-acid solution* was evaporated to dryness, to remove excess of acid. The residue was easily soluble in alcohol; it was less soluble in water, easier in boiling than in cold. A small residue remained undissolved, and was separated by the filter. The solution, on evaporation, left a matter which was partially crystalline; another part deposited in minute flakes. It contained no lime and no soda; it was so hygroscopic that it could not be dried in the water-oven, but had to be dried over sulphuric acid. It was the chloride of a fixed base, which coloured a blue gas-flame violet-red, and gave a yellow precipitate with bichloride of platinum, *potassa*. After having been heated to redness it contained *carbonate of potassa*, showing that the flaky matter had been the potassa salt of an organic acid.

Cholesterine	13·37
Biliary matter, soluble in alcohol	0·10
Colouring matter, Lime, Mucus	0·03
Amorphous cholesterine, with little fatty acid	0·53
Potassa salt of organic acid	0·50
Loss	0·07
	14·60

SECOND SERIES.—*Mixed Calculi, with prevalence of Cholesterine.*

1. Henry.

Organic matter	93·00
Inorganic ,,	7·00
Cholesterine	80·00
Colouring matter, residue	8·00
Biliary matter	5·00
Carbonate of lime	6·00
Carbonate of soda and oxide of iron	—
	99·00

2. Joyeux ('Journ. de Pharmacie,' 1827, p. 548).

Organic matter	94·0
Inorganic ,,	6·0
Cholesterine	80·0
Colouring matter, residue	8·0
Biliary matter	6·0
Carbonate of lime	6·0
Sulphate of soda and oxide of iron	—
	100·0

3. Koninck ('Ann. Pharm.', 24, 289).

Organic matter	99·0
Inorganic ,,	1·0
Cholesterine	94·95
Coloured residue	1·41
Biliary matter	2·53
Volatile oil	0·21
Carbonate of lime	1·00
	99·10

4. Pleischl (in Leo and P., 'Remarkable History of a Gall-stone Patient,' 1826).

Organic matter	99·150
Inorganic „	0·85
Cholesterine	92·719
Coloured residue	1·043
Biliary matter	0·226
Carbonate of lime	traces
Silica	traces
Water	5·290
	99·278

5. Faber ('Ueber den Abgang von Gallensteinen durch die Harnwege,' Tübingen, 1839).

Cholesterine	93·9
Green with little brown colouring matter, carbonate and phosphate of lime	6·1
	100·0

6. Gabr. Pelletan ('Journ. d. Chim. Med.'). Analysis of gall-stones passed from the urinary bladder.

Spec. grav. 1·213 to 1·966.

Cholesterine	95·0
Biliary colouring matter, animal matter, little uric acid	5·0
	100·0

7. L'Héritier ('Traité de Chim. pathol.', 1842, p. 699).

Organic matter	90·39
Inorganic „	9·61
Cholesterine	44·70
Yellow matter	6·07
Green matter	9·12
Carbonate of lime	1·51
Phosphate of „	5·07
Phosphate of magnesia, carbonate of soda, iron	traces
Water	30·49
	96·96

8. Glaube ('Archiv d. Pharm.', 1, 249) analysed some gall-stones which were found in the gall-bladder of a drowned person. They were flattened against each other, and on being held up against the light were found to be transparent. They contained—

Cholesterine	56·0
Cholochrome	15·0
Albumen	9·0
Inspissated bile	8·0
Mucus of the gall-blader	12·0
	100·0

9. Brandes ('Archiv d. Pharm.', 1, 253) has analysed two gall-stones, and found them to consist of—

	I.	II.
Cholesterine . . .	81·250	69·754
Biliary resin (cholic and choloidic acid)	3·125	5·660
Biliary colouring matter . .	9·375	11·378
Extractive matters, mucus, and salts	6·250	13·202

10. A. v. Planta and Aug. Kekulé ('Ann. Pharm.', 1852, 87, 367) examined gall-stones from a man about sixty years of age, who had committed suicide. It could not be ascertained whether he had ever suffered any of the usual symptoms, particularly as he had never consulted any physician. The medical gentleman who performed the legal post-mortem examination found all the other organs besides the gall-bladder in a healthy state.

The gall-stones were densely packed in the gall-bladder, and some adhered to the walls so firmly as to require some violence for their separation.

The weight of the whole of the calculi was 12·5 grammes; they were forty in number, six of them being distinguished by their size, and weighing from 1 to 1·8 gramme.

They were irregular, polyedric balls, and consisted mainly of crystalline cholesterine, which was deposited in layers round the nucleus, and coloured faintly yellow. In the interior they contained a brown, granular substance, with some free-standing crystals of cholesterine.

The analysis was carried out in the manner which had been adopted by Hein (Erdmann's, 40, 47, and 'Pharm. Centralbl.', 1847, 354), and Sthamer ('Arch. Pharm.', [2] 59, 159; 'Pharm. Centralbl.', 1849, 932).

	I.	II.
Absolute weight in grammes .	1·79	1·56
Specific gravity . . .	1·0814	0·789

The specific gravity of the second calculus is a fictitious one, as it was found to contain a cavity filled with air.

Composition in 100 *parts.*

		I.	II.
Loss on drying . . .		4·89	5·02
Matters soluble in alcohol	Cholesterine .	90·82	90·11
	Saponifiable fat	2·02	1·90
Residue	Soluble in ammonia .	0·20	0·54
	Insoluble „ .	1·35	1·56
Ashes (carbonate and phosphate of lime, with a little iron, and traces of chloride of sodium) . .		0·28	0·33
Matter soluble in water . .		0·79	0·54
Loss		—	
		100·35	100·00

11. Hein, J. A., 'Chemical Experiments on Gall-stones and Biliary Colouring Matter,' (Erdmann's, 40, 47). Hein, under the guidance of Marchand, examined the numerous calculi contained in the Pathological Museum of the Clinique of Krukenberg. He selected six lots of calculi, each of which was treated in the following manner.

The specific gravity was ascertained after exhausting the calculi under the air-pump and filling them with water, a process during which a considerable quantity of air escaped through the fissures and holes of some, and even proceeded from such fragments as appeared quite round and solid. After the pieces had again become air-dry, they were finely pulverized; the moisture was determined by drying, and the amount of ash by combustion of a portion. Another part was extracted by digesting it with cold water for several days, and by repeatedly boiling it in that medium. The part insoluble in water was treated with boiling alcohol as long as the filtrate deposited any traces of cholesterine. The residue, finally, was boiled with caustic ammonia so long as the solvent appeared to extract a notable portion of colouring matter; it was, however, found impracticable to complete the extraction with ammonia, as even after twenty decoctions with fresh portions of this alkali the filtrate would yet exhibit a slight colour.

First experiment.—The calculi, five in number, were of an ochre-brown colour, after pulverization ochre-yellow; their size varied between a filbert and a chestnut; their shape was irregular; the structure of the nuclei was fissured, that of the bodies and rinds presented layers; the surface of the fractures had a dead appearance; they were very easily broken.

The second experiment was performed upon one single calculus of the size of a walnut, round like a ball, constructed in layers round an undefinable nucleus, and exhibiting *a blackish-brown colour*, which, after pulverization, was coffee-brown. The calculus was very frangible.

For the third experiment two calculi of a grayish-yellow colour were taken; their powder was light-gray; each was of the size of a walnut, though a little more cylindrical round the middle. The nucleus was fissured in the direction of the rays proceeding from the centre; the body was arranged in layers, and the consistence was soft.

In the fourth analysis fifteen calculi were used; they were all of a yellow colour, lighter after pulverization.

Their size fluctuated between that of peas and beans, their surfaces were flattened, their centres fissured, and their substance was arranged in layers; they were soft, and on fracture had a dead appearance.

Eleven calculi were employed in the fifth examination. Brown on the outside, they yielded a dark-yellow powder; their size was that of vicia-beans; they were facetted, and presented a radiary and at the same time concentrically lamellated structure; on fracture they were glistening, and they showed little cohesion of their substance.

For the sixth analysis twenty-one calculi were taken, of a brownish-green colour outside, but after pulverization of an ochre-yellow colour; in size they varied between that of the lentil and the chestnut; irregular in form, they were throughout of a lamellated structure, dead on fracture and firm on pressure.

The results of the analysis have been perspicuously arranged in the following table:

Number of Experiment . . .	I.	II.	III.	IV.	V.	VI.
Absolute weight . .	11·735	9·154	9·464	12·609	4·947	10·769
Specific gravity . .	1·062	1·270	1·053	1·053	1·069	1·056
Loss in drying, per cent.	4·878	19·179	3·263	2·886	1·974	2·795
Ash	0·588	6·779	1·578	0·497	2·145	0·279
Matter soluble in water, and loss . . .	8·210	10·139	5·014	7·557	3·792	10·472
Matters soluble in alcohol: Cholesterine .	82·815	8·250	82·274	78·058	84·948	76·902
Matters soluble in alcohol: Saponifiable fat . .	1·499	2·700	1·113	4·272	2·295	7·513
Residue: soluble in ammonia . .	0·457	1·116	0·695	0·517	0·127	0·834
Residue: insoluble in ammonia . .	1·553	52·837	6·063	6·213	4·719	1·205
	100·000	100·000	100·000	100·000	100·000	100·000

Only in the second specimen did the specific gravity rise notably above that of water, a circumstance which, perhaps, originated in the large amount of incombustible matter in this calculus, which amounted to almost 7 per cent. The same calculus was distinguished by its large amount of moisture, which is probably owing to the hygroscopical properties of the matter soluble in water of which this calculus contained so large a proportion.

The ash of all six specimens contained chloride of sodium, also carbonate of lime, the quantity of which in No. 2 amounted to 4·288 per cent. of the whole substance of the calculus, or 53·106 per cent. of the ash. All six specimens contained very small traces of iron. The ashes of Nos. 2 and 3 contained, moreover, small quantities of phosphates, and those of Nos. 2, 3 and 5 distinct quantities of manganese. Copper, which was searched for, could not be found in one single instance.

12. Bley ('Journ. f. pract. Chem.', 1, 115) examined gall-stones which floated in a thick matter derived from the gall-bladder. The fluid contained in solution mucus and albumen (Bley terms them ptyaline and fibrine) phosphate and sulphate of potassa, and a yellowish fat was suspended in it.

The gall-stones consisted of the following substances:

Cholesterine	80·0
Phosphate of lime	1·3
Ammonio-phosphate of magnesia	1·0
Silica	0·5
Oxide of manganese	0·3
Water	13·2
	96·3

13. Bibra ('Journ. f. pract. Chem.', v. Erdmann, 1837, 3, 311) analysed human gall-stones, and found in 100 parts—

	I.		II.
Cholesterine . . .	86·1	. .	89·0
Colouring matter . .	10·5	. . .	4·0
Carbonate of lime . .	1·4	Phosphate of lime	1·0
Alumina, containing iron .	1·5	. . .	—
Mucus	0·4	. . .	3·0
Albumen	traces	. . .	traces
Yellow oil	—	. . .	1·0
Water	0·081	Water extract	2·0
	99·981	. . .	100·0
Organic matter . . .	97·1	. . .	99·0
Mineral matter . . .	2·9	. . .	1·0
	100·0	. . .	100·0

14. Calculus observed by Andral, jun.; analysis by Joyeux ('Journ. de Chim. méd.', 7, 750). It was found in a gall-bladder which was perfectly closed, and contained little bile mixed with much mucus.

Organic matter	97·0
Inorganic „	3·0
Cholesterine	33·5
Biliary matter	9·0
Salts soluble in water, chloride of sodium . .	1·5
Phosphates of lime and magnesia . . .	1·0
Water	48·5
	93·5

15. Brandes ('Archiv. d. Pharm.', xii, 256) examined gall-stones from the gall-bladder of a person dead from phthisis. The bladder did not contain any bile. The calculi contained 3·83 per cent. of animal matter and salts soluble in water. Ether left 7·57 per cent. of colouring matter undissolved, and from the residue which remained after evaporation of the ether alcohol extracted 3·83 per cent. of biliary resin, leaving 81·77 per cent. of cholesterine.

Cholesterine	81·77
Cholochrome	7·57
Cholic and choloidic acid	3·83
Matter and salts soluble in water . .	3·83
	97·00

16. Neukomm, in Frerichs ('Klinik d. Leberk.', 2, 530). A large concretion, which had passed from the common duct into the duodenum, and caused death by obstruction of the intestine. It had the form of a cylinder, and measured a little more than three centimètres in thickness; one end of it was rounded off, and exhibited a fissured, bark-like surface, of a brown colour; the other end was broken off, and in the centre of the fracture-surface there appeared a nucleus of 1·5 centimètre's thickness. This nucleus consisted of foliated masses of glass-like crystals, arranged firmly in a radiary position round a centre, and including but little yellowish-brown pigment. Its surface was slightly tuberculated; pressure being applied to the nucleus, it separated into wedge-shaped pieces.

Round the nucleus was arranged, in concentric layers, which might be compared to the annual rings of sections of trees, a yellowish-brown mass, apparently destitute of crystalline structure, and exhibiting a semi-solid consistence, which was compared to that of rotten wood. This layer on the surface of the fracture was 0·7 to 0·8 centimètre in thickness; in the longitudinal axis of the cylinder it was, however, much thicker. It surrounded the nucleus like a shell, and, owing to the greater brittleness of its interior layers, could be separated from it in a very complete manner.

Chemical examination.—The crystalline matter of the nucleus was almost entirely soluble in ether, and the reddish-brown shell yielded to ether upwards of two thirds of its weight of substance. The ethereal solution, which was of a faint-yellow colour, contained principally *cholesterine*, mixed with small quantities of partly saponified, partly non-saponified, fat.

From the residue spirit, and afterwards water, extracted insignificant quantities of salts of biliary acids, mostly mixed with some yellow or green colouring matter.

The reddish-brown powder which was left after these extractions yielded to chloroform a small quantity of cholepyrrhine, colouring the solution faintly yellow. When hydrochloric acid was employed simultaneously a great part of the powder dissolved, the reddish-brown colour disappeared, and a dirty, yellowish-brown, residue remained.

The substances transferred into solution were the following:

Cholepyrrhine, its quantity prevailing.

Green colouring matter.

Biliary acids, sufficient to prove their identity, but quite insignificant in quantity.

Solid fatty acids, fusing at a temperature of 60° C., in small quantity.

With these organic matters the following inorganic bases and salts were combined:

Lime, in preponderating quantity, mostly combined with cholepyrrhine; in very small quantity, combined with phosphoric acid.

Magnesia, in small quantity, accompanying lime.

Iron, in considerable quantity.

Copper, in quantity subordinate to iron.

Manganese, in traces.

The brownish-yellow residue which had been left after repeated extraction with chloroform, and which now yielded only little pigment to this solvent, dissolved mostly in spirit containing some caustic soda. The strongly yellowish-brown solution contained a mixture of brown and green colouring matter.

After removal of the latter there remained reddish-yellow cholepyrrhine, which dissolved only with difficulty in chloroform, and had to be considered as a modification of this pigment, distinguished by impaired solubility.

17. The subject of the following analysis was an oval concrement, measuring twelve millimètres in the shortest and twenty-three millimètres in the longest diameter. Its surface was slightly tuberculated, and formed by a rind, which was about one millimètre in thickness, resembled bone, and could easily be separated.

On a fracture the calculus showed a cortical layer of from one to four millimètres in thickness, consisting of a soft, yet clearly crystalline, grayish-white mass, and a nucleus composed of scales, glistening like glass, closely arranged in a radiary position, interspersed towards the centre and the surface with yellowish-brown matter.

The nucleus and the cortical portion were passing into each other, so that they could be separated only with difficulty.

Chemical examination.—The stony hard plate which was deposited on the surface did not exhibit any crystalline or bony structure. In dilute hydrochloric acid it was soluble under strong evolution of carbonic acid, leaving a few flakes of mucus undissolved. The hydrochloric-acid solution contained much lime, some phosphoric acid, and traces of magnesia and iron.

The cortical portion yielded to ether a large quantity of colourless *cholesterine.*

The residue, consisting of brownish-yellow flakes and granules, was almost entirely soluble in chloroform and hydrochloric acid under evolution of carbonic acid. The hydrochloric-acid solution contained lime, some phosphoric acid, traces of magnesia, and iron. A small quantity of cholepyrrhine had become dissolved in the chloroform.

The glistening scales of the nucleus were completely soluble in ether, the interspersed yellowish-brown granules remaining alone undissolved. The solution contained almost pure cholesterine; in the residue the presence of cholepyrrhine and lime could be discovered.

18. A four-sided concretion, with rounded-off corners and even, grayish-white surface.

The rind consisted of several thin layers, which were coloured alternately whitish, yellowish, or greenish, and in general were rather firm, but did not exceed in the aggregate one millimètre in thickness. Towards the centre the layers became harder, their terminations were indistinct, they assumed a greenish colour, and formed a hard crust of from 1 to 1·5 millimètre in thickness, on the inner surface of which there were, again, whitish deposits visible.

Below this crust there were concentric strata of crystalline scales in radiary arrangement, which enclosed a yellowish-brown pigment. In the centre was perceived a fissured nucleus, with a white frosting of cholesterine.

Chemical examination.—The layers of the crust, after being ground down and digested with ether, yielded to this solvent a small quantity of cholesterine. The residue dissolved in dilute hydrochloric acid under evolution of much carbonic acid, leaving green flakes behind, which consisted mainly of colouring matter of bile.

The hydrochloric-acid solution contained a large quantity of lime, some phosphoric acid, oxide of manganese, and iron.

The loose substance of the nucleus contained principally cholesterine, while the interspersed amorphous masses of pigment contained some cholepyrrhine combined with lime, and a brown matter soluble in alkalies, and containing no nitrogen.

19. Twelve small concretions, of the size of millet-seeds up to that of peas, with whitish-gray, slightly tuberculated but otherwise polished surfaces, some imitating the shape of mulberries. Some of the tubercular projections exhibited an excavation, or even an opening, through which a yellow matter came to light.

On a section of each of these concretions there appeared a yellow-coloured nucleus, consisting of a loose, evidently crystalline matter; it was surrounded by a grayish-white, firm shell, which could easily be cut, and was here and there perforated.

Chemical examination.—Shell and nucleus dissolved almost entirely in ether; the solution was of a faint-yellow colour, and contained almost exclusively *cholesterine*.

The slight residue, consisting of yellowish-brown flakes and granules, contained little cholepyrrhine in a free state, its greater part being combined with lime, traces of other biliary matters, and, besides some lime, definable quantities of phosphoric acid and iron.

20. A great number of small calculi, of the size of poppy-seeds up to that of millet-seeds, in shape oval or roundish, with a smooth, satin-like surface, mixed with some large, bluish-white concretions, exhibiting a tuberculated but smooth and shining surface.

The smaller concretions were somewhat harder and more brittle than wax; their substance was of uniform firmness; only the larger ones among them exhibited a softer centre, of a yellowish colour.

When digested in ether for some days, they almost entirely dissolved, leaving a scarcely perceptible residue. The ethereal solution contained almost pure cholesterine.

The larger concretions, on section, exhibited a firm, grayish-white shell, without crystalline structure, and in the interior a yellowish-brown nucleus, consisting of a crystalline, scaly mass.

The shell, when digested with ether, dissolved entirely, and of the nucleus there remained only a few yellowish-brown flakes. The ethereal solution, which was hardly coloured, on evaporation left cholesterine.

21. Concretions of the size of peas and filberts, enclosed by uneven or plain surfaces, their edges and corners rounded off; some corners appeared as if deposited like warts upon the concretion. The surfaces were smooth, throughout of a rusty-brown colour.

On a section was seen a dark, indistinctly isolated nucleus of amorphous, rusty-brown to blackish-brown matter, round which there were strata of concentric layers of matter, exhibiting a radiating, scaly appearance.

The darker matter of the nucleus, which in some concretions was very slight, formed a reddish-brown powder, which under the microscope exhibited brownish-yellow granules and irregular, scaly, yellow, transparent pieces. On addition of dilute sulphuric acid, minute needles and groups of needles of gypsum soon made their appearance, and were always deposited upon the brownish-yellow granules and lumps, which appeared but little altered.

The lighter layers deposited round the nucleus exhibited under the microscope scales clear like water, of irregular form, and mostly superposed upon each other, and amorphous, yellow matter, which, in the form of granules and flakes, was mixed up with the scales.

Chemical examination.—Ether dissolved the greater part of the concretions. The yellowish solution, on evaporation, left a considerable quantity of almost colourless *cholesterine*, contaminated with a small quantity of a smeary, resinous matter.

The yellowish-brown residue which the ether had left undissolved yielded to chloroform small quantities of cholepyrrhine, which, when the solution was evaporated, was left in crystals of the red colour of granite mixed with some green colouring matter.

When hydrochloric acid was simultaneously employed, chloroform dissolved a considerable quantity of cholepyrrhine, mixed with green colouring matter and traces of biliary and fatty acids. The hydrochloric-acid solution contained principally lime, traces of phosphoric acid, magnesia, and iron.

The residue which remained after this treatment with hydrochloric acid and chloroform yielded to spirit some green colouring matter, to an alcoholic solution of caustic soda a yellow matter, which by hydrochloric acid was also made green, and on evaporation left a green colouring matter in flakes.

The last residue dissolved almost entirely in moderately dilute watery solution of caustic soda, after prolonged boiling; the brown solution was precipitated in flakes by acids. The precipitate contained nitrogen, and burned without leaving essential quantities of ash.

22. Robiquet examined calculi which had been found in the cæcal appendix (vermiform process). They contained—

Adipocere	60·0
Phosphate of lime	30·0
Undetermined animal matter	8·0
Loss	2·0
	100·0

Third Series.—*Calculi with prevalence of Cholochrome.*

1. Neukomm, in Frerichs, loc. cit. Dark, blackish-green concretions, somewhat larger than peas, with uneven,

tuberculated surface, showing here and there pointed projections, and a glistening surface like resin. On slight pressure being applied to one of the concretions, it fell into irregular pieces, all of them very brittle and of a blackish colour, with here and there some light, yellowish-grey, scaly appearances.

Chemical examination.—Ether, spirit, and water dissolved only very small quantities of the powdered concretions. The ethereal solution contained a few scales of cholesterine, besides some colouring matter and smeary fat. In the spirit solution traces of an alkali salt of biliary acid were found.

Chloroform afterwards dissolved some cholepyrrhine, and on evaporation deposited it in a crystalline state and partly transformed into biliverdine.

After treatment with hydrochloric acid, chloroform dissolved a considerable quantity of cholepyrrhine, which contained only little impurity. Spirit afterwards extracted a considerable quantity of cholochloine.

The hydrochloric-acid solution contained lime, some magnesia, small quantities of phosphates of earths, iron, and copper.

The residue which remained after this treatment yielded to an alcoholic solution of caustic soda some cholepyrrhine. Finally, there remained a blackish-brown, mucus-like residue, which was mostly soluble in dilute ley of caustic soda, leaving some brown flakes, which on paper fused into resin-like drops.

The brown solution of caustic soda, on treatment with acid, deposited brown flakes, which, though not referable to any known ingredient or product of bile, consisted, to a great part, of organic matter, containing but little nitrogen.

2. Joyeux ('Journ. de Pharm.', 1827, p. 548).

Organic matter	93·0
Inorganic "	7·0
Cholesterine	4·0
Colouring matter and residue . . .	75·0
Phosphate of lime, " of magnesia, Oxide of iron	7·0
Biliary matter	14·0
	100·0

FOURTH SERIES.—*Calculi with prevalence of Modified Cholochrome.*

1. Such calculi were first distinguished as a separate kind of concretions by Richard Powell, in his 'Observations on the Bile and its Diseases,' London, 1800, p. 111:—"The amorphous concretions are such as bear no marks of crystallization or rather regularity of structure, and which seem to contain none of that peculiar matter which characterises the crystallized and stratified calculi. . . . For the most part, such concretions have an irregular, shining fracture, falling into pieces on the application of the slightest force. They are, in their colour, commonly black, and may be considered as resembling coal. When they break into layers, I have noticed that their external colour is very frequently a deep bottle-green." On p. 128 Powell describes the chemical behaviour of such calculi as follows:—"They were remarkably friable, felt gritty in the mouth, and had no perceptible bitterness or other peculiarity of taste. They did not inflame, and almost generally sank in water, which was noted both by Brandes and Morgagni. Alcohol or water, even when boiling, acquired no impregnation and were not altered in their colour. Ether assumed a deep-green colour, but even after a digestion of many days, with repeated additions, the concretion still seemed

to retain its original state and colour. The coloured ethereal solution yielded no crystals on evaporation, but an extractive mass. The residuary skeleton of these concretions appeared to be pure carbon in every other respect, and on being exposed in a jar of oxygen gas, inverted over mercury, to the focus of a burning lens, it was, with the exception of a slight film, converted into carbonic-acid gas.

Alkalies dissolved a considerable portion of these concretions, and formed a deep-brown coloured liquor, which, when diluted, had a green tinge. Nitric acid, assisted by heat, dissolved them readily, and gave a bright, reddish-brown solution.

The ashes of a small portion of this concretion, which had been burned in the focus of a burning lens, had a little water added to them, and received an alkaline impregnation, which was evident from the alteration of paper tinged by the blue colour of violet.

2. The following case is related by Buisson, 61 :—Mdlle. Josephine H—, æt. 22, of lymphatic temperament, with scanty and irregular menses, suffered since childhood of scrofula. In the early part of 1839 she complained of pain in the epigastric and *left* hypochondriac regions, to which vomiting, at first of biliary matters, at last of blood, supervened. Appearances then pointed to a disease at the basis of the breast, but they soon made way to the old pain in the epigastric region and to vomiting. These symptoms were for some time kept under control by astringent and narcotic remedies, but after a few months the pains in the epigastric and the left hypochondriac region returned with the greatest severity, and there ensued vomiting of black matters, which, after drying, were similar to ground coal. Of this matter the patient daily vomited seven or eight times, and in consequence she became so reduced that

she frequently fainted. The vomited matters were sometimes concreted into balls. The largest balls were of the size of a nut, with an uneven, porous surface, and uniform, dull-black colour. They were analysed by Bernard, and recognised to be gall-stones of a carbonaceous matter, which had formed from biliary colouring matter, and corresponded exactly to that rare modification of gall-stone which has been described by Powell in his researches on gall-stones. The patient derived but little benefit from remedies, and died early in the year 1842, after having on repeated occasions vomited and passed by stool masses of black matter resembling those above described. She had also had attacks of catalepsy, and various secretions had assumed a black colour. The post-mortem examination was not permitted.

Buisson examined some of the gravel (the coalesced masses, examined by Bernard, he describes himself as calculi) which had been collected by filtration of the fluid. It appeared as a fine powder, or as pieces of a roundish or scaly shape. They had a bitter taste, and on exposure to air attracted some moisture:

3. Fauconneau-Dufresne has also observed black gall-stones, and found them irregular and covered with projecting points.

4. Jaeger (Meckel's 'Deutsch. Archiv f. d. Physiol.', 6, 485) believes to have found carbon in the blackish-green, metallic, shining rind of some gall-stones which he examined.

5. Garot examined some gall-stones, which, from their external appearance, seemed to belong to this class, and found them to contain a peculiar fatty oil, besides altered mucus or albumen impregnated with some colouring matter.

6. Bérard states that these calculi consist of colouring

matter which has changed in such a manner that its carbon is in excess relatively to the other elements of which it is composed. Buisson (80) remarks they could not consist of carbon only, as they were discoloured by chlorine.

7. Hein examined biliary concretions consisting of small, jet-black, glistening granules, cemented together in groups and masses. They could easily be ground down to a glistening, black powder; the entire available material, however, only amounted to 0·2 gramme. Alcohol did not extract any trace of cholesterine, and only small, not ponderable, quantities of saponifiable fat; boiling ammonia dissolved a small quantity of matter, which, on addition of hydrochloric acid, was again precipitated, but the deposit had a brown, not a green, colour. On combustion, there remained a large amount of dark ash.

8. The calculi which served for the following analysis were presented to me by Dr. Wilks, of Guy's Hospital:—They were 118 in number, weighing thirty-one grains. Of these, 110 were single concretions; 5 consisted of two calculi each, firmly cemented together; 1 consisted of three, another of five, and 1, the largest, of seven or eight, single grains, cemented together. The calculi were uniformly of the size of small, shrivelled peppercorns, had a greenish-black tinge, on fracture were black and glistening like jet, and exhibited the following reactions:

When powdered, they proved very brittle, fragments being thrown out of the mortar in all directions. The powder, at first glistening and jet-black, on continued trituration lost its shining appearance, and became greenish-brown.

Heated on platinum, they swelled up, emitted slight fumes of the smell of burning animal matter, took fire, and burned with a yellow flame, then glowed as cinders for a long time, and were gradually consumed at a white heat, produced by means of the blowpipe. Some left a trace of fusible ash, others a little solid, brownish-black ash, effervescing with hydrochloric acid; it contained iron, phosphates and carbonates of lime, and magnesia.

Cold hydrochloric acid effected hardly any change upon the rough fragments of a calculus. Caustic potassa, after several hours, had only acquired a slight greenish tinge, and softened the fragments a little, but had otherwise left them unchanged.

Nitric acid effervesced with the calculi, and on heating dissolved them completely under evolution of red vapours and the production of a cherry-red, clear solution. This solution, boiled until all red vapours had been driven out, gave a copious yellowish-red precipitate when mixed with water. The precipitate was soluble in caustic ammonia, with a red colour.

Treated with hydrochloric acid and chlorate of potash, the powder became changed; its colour became yellow, and continued to grow paler the longer the influence lasted.

These reactions characterised the calculi as consisting of cholochrome in a very dense and somewhat modified state, mixed or combined in part with lime and phosphate of lime and magnesia.

Exactly the same reactions as those exhibited by these calculi were observed upon small fragments of the black, hard mass which remained on the filter when human bile was extracted with alcohol.

9. These calculi I took from the gall-bladder of an old man who had died of mollities ossium, involving fracture of the thigh and humerus.

The calculi were twenty in number, and varied in size from that of a large pea to that of a small lentil. They altogether weighed 18·9 grains. The large ones consisted of many small ones fused together, and showed the same mode of formation as the calculi in the previous case. They were black in colour, and looked like small, shrivelled peppercorns. They were gritty upon the teeth, without any bitterness, nearly tasteless. They were easily broken, jet-black, and glistening on a fracture. Heated, they cracked a little, then softened, emitted fumes, took fire and burned with a strongly yellow flame, and ultimately left a black, charred residue, of almost the original bulk of the calculi. This was not incinerated by exposure to prolonged white heat. But when the salts were washed out with water, incineration of the residue could be effected. The ash which remained, fused in part at a white heat and moistened with water, had a strongly alkaline reaction. The infusible and insoluble part effervesced with hydrochloric acid, and yielded a yellowish solution; this solution gave a blue precipitate with ferrocyanide of potassium (*iron*), a white, flocculent one with ammonia (*phosphate of lime*), and another with carbonate of ammonia (*lime*). The soluble alkaline salt was *soda*.

Triturated in a mortar, the calculi proved very brittle, and gave a jet-black powder of great shining splendour. Continued trituration made the powder more dead and somewhat brown. In nitric acid the powder immediately dissolved, forming a red solution, which was expedited by heat; the solution, on the addition of water, gave a copious orange-coloured deposit.

Chlorate of potash and hydrochloric acid coloured the black powder red, ultimately yellowish-red.

Caustic potassa in the cold scarcely affected the powdered calculi; but when the mixture was heated the potassa assumed a brown colour, which became the deeper the longer the heating was continued. The solution was favoured by the repeated addition of some water as the fluid became concentrated. Some black matter remained undissolved. The solution, after filtration, was dark reddish-brown, and with excess of hydrochloric acid deposited *cholochloine*. Nitric acid transformed the green colour of the precipitate into red, and gave a red colour to the solution.

The black residue, insoluble in potash, yielded to hydrochloric acid a yellow matter, mostly *iron*, with some cholochrome and inorganic salts. But after this treatment it continued insoluble in boiling caustic potassa, but was easily soluble, first with a red, afterwards a yellow colour, in hot nitric acid. In the solution water produced the orange-coloured deposit.

The powdered calculi yielded to boiling absolute alcohol a vestige of brownish matter.

10. An almost octahedral, dark-brown, nearly black gall-stone, from the gall-bladder of an aged female; weighed 12·6 grains; its crust was broken in many pieces and easily detached. It had a light-brown, small nucleus, and showed some arrangement in layers. In the mortar it first gave a powder, which glistened like charcoal and was black. On continued trituration it lost its glistening appearance, and became of a dead, dark-brown colour.

Heated on platinum foil, it emitted the usual fumes, burned, and left grayish-brown cinders, which, saturated by water and heated again, became gray. Dissolved in hydrochloric acid, they effervesced a little; the solution deposited a thick precipitate by excess of ammonia, phosphate of lime, of which a part crystallized on standing, ammonio-phosphate of magnesia; it also contained iron and a trace of copper.

In caustic potassa the powder dissolved in part, forming a dark-brown solution; another part remained black and undissolved. The solution gave a green precipitate with hydrochloric acid—cholochloine.

The powder rapidly dissolved in nitric acid on mixing, forming a red solution, which, on addition of water, gave an orange-coloured precipitate.

Fifth Series.—*Gall-stones with prevalence of Bile-Acids.*

1. *Calculus of lime-salts of biliary acids, and cholochrome, free from cholesterine.*—(Neukomm, loc. cit.) An almost cylindrical concretion from the biliary passages of a man aged 54. It was three centimètres in length and 0·7 centimètre in thickness; in colour blackish-green, in consistence hard and brittle. The rough surface had a dirty appearance, but the surface of a recent fracture was shining like resin.

Chemical examination.—Ether dissolved a yellowish, oily substance, which, on exposure to air, became gradually resinous; exhibited a strong reaction of biliary acids, but did not contain any cholesterine.

Spirit of wine extracted a considerable quantity of salts of biliary acids, containing partly alkalies, partly earths, particularly lime. This latter salt was deposited from the alcoholic solution in microscopic, shining balls, with dark outlines, which had a great resemblance to balls of leucine.

After sufficient extraction with spirit the matter of the concretion was treated with dilute hydrochloric acid. The faintly green solution contained a considerable amount of lime, some magnesia, small quantities of phosphates of earths, iron, and copper.

The residue yielded to spirit, besides some colouring matter, a considerable quantity of a biliary acid, which crystallized from the bleached solution in tender, silk-like bundles of needles, and on drying collapsed very much.

They yielded an intense reaction of biliary acid; their properties and their bearing towards solvents made it likely that they consisted of glycocholic acid, but their quantity was not sufficient to institute a decisive examination. The concretion finally left a small quantity of a blackish matter, which was soft and flaky while moist, and on drying became humus-like. It principally consisted of organic matter, containing nitrogen, but only an insignificant amount of ash.

2. Fauconneau-Defresne ('Rév. Méd.', i, 1841, and 'Mém. de l'Acad.', 13, 226) has described a kind of gall-stones which he terms resinous calculi. They are easily friable, and after grinding form a yellowish-green powder, like ground aloes. They are almost entirely soluble in alcohol, ether, oil of turpentine, and alkalies. After extraction with ether there remains a small quantity of a smeary, white substance, possessing the properties of mucus. The ethereal extract, after filtration and evaporation, leaves a yellowish-green matter, which is transparent, without odour, and after drying can easily be powdered. By heat it fuses, forming a transparent fluid, and exhaling vapours of a balsamic odour, until it is at last transformed into a light charcoal. From these properties Garot concluded that the principal ingredient of these calculi was almost pure resin of the bile (Thénard's). It is highly probable that it was *cholic acid*, to the reactions of which those above related closely correspond.

3. An analysis of Orfila ('Ann. de Chim.', 74, 34) yielded a certain quantity of picromel, combined with fat and colouring matter.

4. Caventou ('Journ. de Pharm.', iii, 1817) also obtained picromel from a calculus weighing between twelve and thirteen decigrammes.

There are some notices of concretions alleged to have consisted principally of inspissated bile. Buisson says that he observed some which came from the liver of an ox. In the human subject they have also been found, of a soft consistence, attracting moisture on exposure to air, possessing a very bitter taste, and having a higher specific gravity than cholesterine calculi. They are said to be soluble in water, alcohol, ether, and turpentine. The solubility in ether is, however, a circumstance which militates against their consisting of unaltered bile, and points to their probably containing principally cholic acid.

SIXTH SERIES.—*Gall-stones with prevalence of Fatty Acids.*

1. Frerichs (2, 537) found margarate of lime to be the chief constituent of a human gall-stone contained in the museum at Goettingen, and examined by him in 1847.

It had an oval shape, a smooth surface, and a yellowish-brown colour; the surface of a fracture was of a resplendent white colour, and showed a radiary crystalline structure. In the centre there was a brown fissured nucleus, of the size of a lentil, and consisting of a compound of cholepyrrhine and lime and mucus. The white friable substance was only to a small part soluble in boiling alcohol and ether; the alcoholic solution, on evaporation, left plates of cholesterine, small balls, and needle-like crystals. The part insoluble in alcohol yielded to acetic acid much lime, and was then easily soluble in boiling spirit. The latter left crystalline scales of fatty acid. The melting point of this fatty acid was 58° C. (136° Fahr.). Neukomm determined it once more at 58·5° C. (137·3° Fahr.). The fatty acid from the gall-stone of an ox he found to fuse at 53° C. (127·4 Fahr.).

The quantitative analysis of the above calculus yielded—

Margarate of lime	68·0
Cholesterine	28·0
Cholepyrrhine and lime	3·0
Mucus, &c.	1·0
	100·0

2. *Calculus consisting principally of fatty acid.*—This calculus was discovered in the collection of John Hunter, had by him been placed among the human urinary concretions, and was supposed to consist of the earthy phosphates. It was unaccompanied by any history, and it must therefore remain doubtful whether it was taken from the human subject or from one of the lower animals.

It was of dirty white colour, and had the greasy feel of cholesterine calculi; it floated on water, and when applied to the tongue left an impression of bitterness. It was of an oval figure, slightly flattened, one inch and a half in length, rather better than an inch in thickness, and about one inch and a quarter in breadth. It readily yielded to the knife, and the cut surface presented a polished appearance; its structure was lamellar, being composed of white and reddish-yellow layers, arranged concentrically and alternating with each other. The layers were easily separable; at its centre there was a small vacuity.

When heated before the blowpipe it readily fused, then caught fire, burning with a clear flame and giving out the smell of animal matter, but nothing of a urinous character. It left a carbonaceous residue, which, by raising the heat, was converted into a white ash. This ash was alkaline, dissolved in water and dilute acetic acid, and the solution gave a white precipitate with oxalate of ammonia; it was, therefore, *lime*.

When digested in boiling water, the water became slightly brown, and on evaporation a transparent, yellowish-brown residue was left, which had a bitter taste and consisted of inspissated bile.

Boiling alcohol extracted from it only a minute quantity of white, fatty matter, which was deposited on cooling.

A solution of caustic potass removed the whole of the colouring matter, but the rest of the calculus was unacted on; the potass solution was dirty green, and when neutralized with muriatic acid deposited a scanty precipitate, having the same tint.

When digested in nitric acid, effervescence took place, with the escape of a little nitrous acid; it then melted into a transparent oil, which, on cooling, concreted into a white, fatty matter. This substance, when washed with distilled water, melted at a temperature much below that of boiling water.

When, instead of nitric acid, muriatic or acetic acid was employed, the portion of calculus did not melt until it had been removed from the acid; it then presented similar appearances to that obtained by the action of nitric acid; consequently this white, fatty matter was not formed by the action of the nitric acid.

In all these cases the acids retained lime in solution. The fatty matter, separated by the action of acids, was partially soluble in boiling alcohol, and the solution, on cooling, deposited shining, crystalline scales. With caustic potass it formed a ropy, almost gelatinous solution, and was precipitated in white flakes on the addition of an acid. A small piece being placed upon the ball of a thermometer previously heated, began to solidify when the temperature had sunk to about 135° Fahr.

From these experiments there could be no doubt that this calculus consisted of margarate or stearate of lime, mixed, probably, with the oleate of the same base and some of the other constituents of the bile. That the lime was in combination with the fatty acid was indicated by the insolubility of the calculus either in alcohol or caustic alkaline solutions until it had been previously digested in an acid.

To determine whether one or more of the fatty acids were present, the following analysis was made :

12·80 grs. of the calculus, previously dried *in vacuo* over sulphuric acid, were boiled in distilled water ; a peculiar odour was given off, and the water acquired a yellowish-brown colour; being evaporated to dryness, it left a transparent, resinous-looking residue, which weighed 0·84 gr. This residue, when digested in alcohol, left 0·24, in the form of dirty yellow flakes, which in distilled water swelled up and ultimately dissolved, forming an imperfect solution which, in its chemical characters, exactly resembled that of the mucus of the gall-bladder.

The alcoholic solution being evaporated to dryness, the residue was redissolved in water; the solution was intensely bitter; with muriatic acid it gave a copious viscid precipitate; acetate of lead produced likewise a viscid precipitate, and the supernatant liquor, when clear, was again troubled by a solution of sub-acetate of lead.

The 0·84 consisted, therefore, of—mucus of the gall-bladder 0·24; inspissated bile, 0·60 gr.

After water had extracted from the calculus all that it was capable of dissolving, it was treated with successive portions of boiling alcohol, sp. gr. ·830.

The first alcoholic solution, on cooling, deposited a white matter, which did not readily redissolve in hot alcohol or ether, but was acted upon by acetic acid. It appeared to be part of the calculus that had been dissolved unchanged ; the quantity was, however, too minute to be estimated.

The aloholic solutions were filtered, and, being mixed together, the whole was gently evaporated; as the liquid became concentrated it deposited some white, fatty matter, and acquired a yellow tinge; a residuum was ultimately left, which had the appearance of a mixture of a fluid and a concrete, oleaginous substance. On the application of heat it became a yellow oil, which, on cooling, only partially solidified; it weighed 0·47 gr. This matter strongly reddened litmus paper, dissolved readily in a cold solution of caustic potass, and was precipitated in soft flakes on the addition of an acid. It consisted, therefore, of oleic acid, mixed with margaric or stearic acid.

Strong acetic acid, diluted with twice its bulk of water, was now poured over the calculus, and the action of the acid aided by a gentle heat. The insoluble residue was collected on double filters, washed and dried.

The acetic solution, with its washings, was reduced to a small bulk, and a solution of ammonia added; after the lapse of several hours, no precipitate appearing, the excess of ammonia was nearly neutralized by a solution of oxalic acid; a white precipitate fell, which, when washed, dried, and heated to dull redness in a platina crucible, left 2·09 grs. carbonate of lime = 1·17 gr. lime.

The remaining liquid being evaporated to dryness and the ammoniacal salts expelled, a residuum was left, which weighed 0·10; water dissolved a portion of this; the solution was alkaline, and when evaporated, minute crystals were formed, which slightly effervesced in acetic acid; their solution not precipitating chloride of platinum, left little doubt of their being carbonate of soda; the small portion which remained undissolved proved to be carbonate of lime.

The matter left upon the filter after the action of the acetic acid was again digested in boiling alcohol; a considerable portion dissolved, and the remainder had acquired a much deeper colour; it was collected on the same filters, which were repeatedly washed with boiling spirit; when dried and weighed, it amounted to 0·86. This substance possessed a brownish-yellow colour. It dissolved in solutions of caustic and carbonate of potass, forming solutions having nearly the same tint.

Muriatic acid rendered it green, and when added to its alkaline solution threw down green flocks.

With nitric acid it formed a red solution.

This substance was, therefore, identical with the colouring matter of the bile.

The alcoholic solutions were concentrated by careful distillation in a small retort; the liquid remaining in the retort, when cold, formed a soft, crystalline mass, composed of brilliant plates and having a pearly lustre, very much resembling margaric acid.

The crystalline matter, when fused and kept for some time *in vacuo* over sulphuric acid, weighed 8·88. It melted at 136° Fahr., and on cooling, became a crystalline solid, which reddened litmus paper and was easily soluble in a cold solution of caustic potass; the solution, when concentrated, was ropy and gelatinous; when dilute, it formed a slightly milky mixture, with minute, glistening particles floating in it; on the addition of an acid, the substance was thrown down in the form of white flakes, which possessed the same properties as before solution. When boiled with the alkaline carbonates, it was dissolved, with the escape of carbonic acid. By redissolving it in hot alcohol, crystalline plates were deposited on cooling, which, after washing with cold spirit, fused at about 140°. The low fusing point of this substance evidently indicated the presence of oleic acid. In order to ascertain whether the crystals fusible at 140° were pure margaric acid or stearic acid rendered more fusible by an admixture of oleic acid, they were again dissolved in warm spirit, and the crystals, as soon as formed, dried by compression between folds of blotting-paper; by repeating this process two or three times, the fusing-point was raised to nearly 160°. These crystals must, therefore, be regarded as pure stearic acid; and as it was found that both stearic and margaric acids require to be several times re-crystallized from their alcoholic solutions to free them from even small quantities of oleic acid, and as no decided indication of the presence of margaric acid could be detected in the mother-liquors, it is probable that only oleic acid had been separated by the above treatment, and that consequently margaric acid did not enter into the composition of the calculus. It would, however, be impossible to speak decidedly on this point.

The result of the analysis is as follows:

Stearic acid, mixed with a small proportion of oleic acid	9·35
Lime	1·17
Soda, with trace of lime	0·05
Yellow colouring matter of the bile	0·86
Inspissated bile	0·60
Mucus of the gall-bladder	0·24
Loss (a small particle of stearic acid was thrown out).	0·53
	12·80

(Catalogue of the Museum of the Royal College of Surgeons.)

SEVENTH SERIES.—*Gall-stones with prevalence of Carbonate of Lime.*

1. Bally and Henry fils ('Journ. de Pharm.', 15, 196; extract in 'Ann. Chim.', 2d series, 44, 442.) Bally had extracted the calculus from the gall-bladder of a living woman. After it had been isolated from a slimy, ichorous, yellowish

matter, it showed the following properties :—it was white, of the size of a small filbert; in shape, it was an elongated ovoid; while fresh, it was soft, but subsequently became harder. Its granular texture showed two or three places which looked like petrified, but having been detached and looked at with the loupe, they exhibited distinct crystallization. On its surface were two points coloured by a greenish matter, probably bile. It was composed of—

Animal matter, analogous to mucus or albumen	10·81
Carbonate of lime	72·70
Phosphate of lime	13·51
Oxide of iron, fatty and colouring matter of bile, and loss	2·98
Total	100·00

The total absence of cholesterine is particularly remarked.

2. Marcet ('Journ. de Pharm.', 13, 43) described a biliary calculus from man, which was composed exclusively of carbonate of lime and green matter from bile.

3. Steinberg ('Dissertatio de concretionibus alvinis et ptyalithis, cholelithis, cystolithis,' Halæ, 1842).

Organic matter	5·0
Inorganic ,,	95·0
Cholesterine	1·50
Carbonate of lime	84·75
Phosphate of lime	10·25
Animal matter	2·25
	98·75

4. Buisson and Dubreuil observed blackish-brown, hard, uneven, heavy calculi; their surface in some places was tuberculated, in others covered by projecting rays. The chemical analysis performed by Gerhardt, then professor at

Montpellier, showed that they were entirely composed of carbonate of lime, and that the blackish colour of the surface was due to a small quantity of dried bile.

5. J. A. Hein (Erdmann's 'Journal,' 40, 47).

Six small calculi were found in a gall-bladder. They were firm, hard, not easily broken; their surface was dark brownish-green, perfectly without lustre; the points of the projections or branches were whitish-yellow, and looked as if worn by contrition. In the interior these calculi were yellowish-green and quite solid. One of them weighed 0·140 grm. Alcohol did not show any trace of fat in it, and ammonia extracted so little that it could not be determined by weight. The ash, however, amounted to 88·333 per cent. of the weight of the whole. It consisted almost entirely of carbonate of lime, a small quantity of sulphate and phosphate, some iron, and 1·666 per cent. of the whole of silicic acid.

Gall-stones of Animals.

Gall-stones have been discovered in almost all classes of vertebrate animals, particularly those which have been domesticated. Of wild animals, only such as have lived for some time in a state of captivity have been observed to be liable to the disorder. While they are common in oxen and cows, which possess a large gall-bladder, they are much rarer in animals which are naturally deficient of a gall-bladder, such as the horse and the elephant. Among horses, however, gall-stones are said sometimes to be epidemic ('Kramer, Medic. milit.', 2, 175). The gall-stone of an elephant which died in the Jardin des Plantes at Paris, and was taken care of by Seba, became the subject of an analysis by Thénard.

The carnivorous animal imitates closely the diet of the sucking young, and shares its almost perfect immunity from gall-stones. Indeed, there is no example which I could quote of a gall-stone found in a wild flesh-feeder. The case of Seba ('Thes.', t. ii, tab. 113), who found a gall-stone in a tiger, is questionable as to whether the animal had not been imprisoned for a length of time and been compelled to live under most unnatural conditions. Planque ('Excerpt. Lit.', 1759, No. 3) found gall-stones in a dog. Even this case would hardly constitute an exception to the rule of the immunity of carnivora, as the dog has frequently to live upon the most unnatural fare, and practically becomes an omnivorous animal. Yet even among omnivorous dogs and cats gall-stones are so rare that I never met with one, nor have I heard of any having been found in the many hundreds of dissections of dogs which have been made during the last ten years in the course of physiological and surgical experiments in the metropolis and elsewhere.

Crisp ('Transact. of the Path. Soc. of Lond.') found gall-stones in the gall-bladder of a cava which had died in the gardens of the Zoological Society of London.

Pigs and monkeys harbour gall-stones which have great similarity with those of man. Lower down I have given the analysis by Lassaigne of the gall-stone of a sow, which has a particular interest as bearing upon the theory of gall-stones.

The gall-stones of the hedgehog are said to be peculiarly bitter. Like most other gall-stones, they at one time possessed a great celebrity in consequence of the use which some polypharmacist physicians made of them. In the north of Africa, more particularly Algiers and the adjoining states, the hedgehog is very common, and much hunted by a brotherhood of sportsmen, who are also given to hashish eating. It was among their predecessors, probably, that the gall-stone of the hedgehog became first known and appreciated.

Bouisson (46) found a perfectly transparent gall-stone of crystalline texture in the foramen of the ductus choledochus of a rabbit. Among other rodentia, more particularly in beavers, gall-stones have been observed.

Ambergris is generally believed to be a pathological product derived from the pott-whale, in whose intestines it has sometimes been found. Some have declared it to be the gall-stone peculiar to the pott-whale. This opinion derives additional strength from the circumstance that ambergris contains a crystallizable substance nearly related to cholesterine, and being probably an ether of this alcohol. It also contains a small quantity of colouring matter similar to that of other gall-stones.

Among birds gall-stones are rare. To the Egyptian kings and priests, who dissected the bodies of men and animals, the gall-stones of the ibis became known. Bouisson examined the bile of fowls, and sometimes found it to contain minute, yellowish lumps.

Of amphibia, one, at least—a tortoise—has been known to produce a gall-stone ('Mém. de l'Acad. des Sc.', an. 1729, No. 5).

Of fishes, Haller remarked, "in piscibus etiam globuli albi duriusculi reperiuntur." Bohn ('Circa Anat. phys.', pp. 233-6) states that they are found in fishes which have no spleen, and in this respect form the transition from the vertebrate to the invertebrate animals.

In the hepatic ducts of invertebrate animals, Blainville ('Physiol. gén. et comp.', tome iii) found concretions which, he says, from their seat, had to be considered as biliary.

Aubé ('l'Institut.', No. 135, p. 394) found in the so-called biliary ducts of a kind of lucanus calculi of the thickness of some millimètres. They consisted principally of uric acid. From this analysis Audouin endeavoured to conclude that these passages which open into the lower end of the intestine serve, not only to carry the bile, but also to conduct the urine of insects.

It is, however, quite certain now that insects do not possess any separate organs analogous to the liver of higher animals, and that the function which corresponds to the formation of bile is not located in the Malpighian organs, but is part of the function of the chyle-stomach (ventriculus) and of the vermiform appendages of this stomach which are found in many of these animals. The Malpighian vessels, which were for a long time considered as biliary organs, must now be explained as urinary organs exclusively. Rengger already, in 1817, made this hypothesis ('Physiol. Researches on the Economy of Insects,' p. 27), but without proving the nature of their secretion to be that of urine. This chemical proof was furnished by Brugnatelli and Wurzer, by means of analyses performed upon the urinary secretion of *Bombyx mori* (*vide* Meckel's 'Deutsch Archiv,' vol. ii, 1816, p. 629, and vol. iv, 1818). The presence of uric acid in the secretions of the Malpighian vessels of *Melolontha vulgaris* was afterwards found by Chevreul (see Straus, 'Considérations,' &c., p. 251). The same substance was found by Audouin in *Lucanus cervus* and *Polistes gallica* ('Ann. des Sc. nat.', tom. v, 1836 p. 129). Compare Meckel, on the biliary and uropoietic organs of the insects, in his 'Archiv,' 1826, p. 21, and Groshans, 'De systemate uropoëtico, quod est Radiatorum, Articulatorum, et Molluscorum Acephalorum,' 1837, p. 39; Siebold, 'Comparat. Anat.', Berlin, 1848, pp. 606 and 620.

Gall-stones in insects could, therefore, only exist in the vermiform appendages of the ventricle, or in the ventricle and subsequent parts of the intestines themselves Of such concretions there exists as yet no record.

Analysis of Ox Gall-stones.

The gall-stones are powdered, and boiled with water during three hours. The dark-brown extract is removed by filtration, and the residue on the filter washed during three days with boiling water—that is, until the filtrate comes away colourless. The powder is then dried in the water-bath.

It is then boiled for several hours with alcohol of 80 per cent. strength, which also acquires a dark colour, and is separated by filtration. The residue is for several days washed with boiling alcohol, and dried. The primary filtrate is allowed to cool by itself, and the washings are evaporated by themselves. The alcoholic extract is further analysed, as will be detailed lower down.

The powder is next mixed with water in a flask, and a quantity of hydrochloric acid added. A slight frothing ensues, and the smell of sulphuretted hydrogen is at once perceptible; lead paper is turned black by the gas. It is therefore necessary to perform the extraction with hydrochloric acid in a gas-evolution bottle, with funnel for the addition of the acid, and two tubes, one for passing a current of air through the acid fluid, the other for conducting the gases through an alkaline solution of arsenious acid, coloured blue by litmus. In my analysis this alkaline solution was contained in two bottles, and as soon as the acid vapours had coloured the litmus red, the first bottle was removed, the second bottle put in place of the first, and a new bottle in the place of the second. All the sulphuretted hydrogen was driven out of the mass by boiling and passing a current of air through the mixture, and absorbed in the alkaline fluid. The united solutions, on addition of an excess of hydrochloric acid, precipitated yellow flakes of a sulphur-compound of arsenic, which, collected on a filter, washed and dried, weighed 1·8 grain, corresponding to 0·743 grain of hydrosulphuric acid. On drying, this precipitate became brown and hard, and on sublimation yielded tersulphide of arsenic, as already stated, besides a quantity of charcoal. That so small a quantity of this sulphur-compound should have been obtained from about six ounces of gall-stones is explained by the experience of Bolle, who analysed two gall-stones, only one of which yielded sulphuretted hydrogen.

The residue which remains after the removal of the hydrochloric-acid extract consists of cholochrome, with traces only of the original admixtures.

The water-extract, on evaporation, yields a syrup, of a faintly acid reaction. It is soluble in water and spirits, and no crystalline organic compound is deposited from it, even after months of repose. But it has the remarkable property of holding in solution, and at length depositing in well-defined, large crystals, phosphate of lime.

WATER-EXTRACT OF OX GALL-STONES.

Diluted with water, and treated with dilute sulphuric acid, it immediately deposited a soft resin, of a brown colour. This was collected and removed in a lump from the fluid. The acid solution continued to be turbid, and was therefore heated for some time, and then filtered; but the suspended matter passed through the filter. After weeks of standing, the precipitated matter had collected at the bottom, and the dark-brown fluid was clear. It was removed by decantation, and the deposit was collected. The three parts, namely, the first resinous and the second pulverulent precipitate, and the acid mother-liquor, were further treated as follows:

Resinous precipitate.—It was washed with water by kneading with a pestle in a mortar, and then dissolved in hot concentrated alcohol. The solution hardly deposited anything on cooling and standing, and on the addition of small quantities of ether. To the solution baryta water was added, and although at first no precipitate was perceptible, a deposit ensued when the solution was concentrated.

This deposit was collected on a filter, washed with water, and then boiled with absolute alcohol. Scarcely anything dissolved in this agent. The deposit was then decomposed with hydrochloric acid, which took place under slight effervescence, owing to the presence of some carbonate of baryta. The residue was washed with water, boiled with alcohol, and thrown on a filter. The filtrate, on cooling, deposited crystals, being needles in balls and branched masses, which were fusible by heat and perfectly combustible on platinum foil. The insolubility of the baryta salt in water and boiling alcohol, and the solubility of the acid in boiling alcohol and its crystallization in needles, characterise it as *cholonic acid.*

The solution from which the cholonate of baryta had been deposited contained a considerable amount of a brown baryta salt, which was soluble in water and alcohol, not crystallizable, and appeared to be *glycocholate of baryta.*

The pulverulent deposit was dissolved in alcohol, and, after this solvent had again been evaporated, remained as a resinous matter. Potassa combined with this resin, forming a solution in which an excess of potassa formed a precipitate. The excess of potassa, containing a little matter in solution, being removed by decantation, the precipitate readily dissolved in water. From this solution a resin was precipitated by chloride of ammonium. This resin consequently was *cholonic acid.*

The *fluid* from which the biliary acids had been precipitated by sulphuric acid was distilled; the distillate had a very bad smell, and contained hydrochloric acid, scarcely anything organic. The fluid in the retort deposited some dark resin during the boiling. It was treated with carbonate of baryta and baryta water to remove sulphuric acid. The brown alkaline filtrate was again distilled, and the distillate evaporated with some hydrochloric acid. A small quantity of a crystalline chloride of a strongly smelling, probably compound, *ammoniacal base* remained. The fluid in the retort, after further concentration in a china dish (further distillation having become impossible by the frothing of the mass), deposited cystals of *carbonate of soda.*

The water extract of ox gall-stones yielded, therefore, the following substances:

Phosphate of lime.
$\left.\begin{array}{l}\text{Glycocholate}\\ \text{Cholonate}\end{array}\right\}$ of soda.

Hydrochlorate and carbonate of soda.
Ammoniacal base.
A matter having a very repugnant odour.
A syrupy, brown mother-liquor.

HYDROCHLORIC ACID EXTRACT OF OX GALL-STONES.

When this extract was repeatedly evaporated to dryness it deposited a dark-brown precipitate, which consisted of *cholochrome* and some inorganic matter, which, on incineration, was left as a white, fixed *residue*. The ingredients of this residue will be stated lower down. The extract at last was a thick, acid syrup, in which, on standing, some uncertain crystallization ensued. Mixed with some water, it represented a dark-brown solution, which smelled like an old bottle of pickled onions, and coloured black the inside of a stoppered bottle made of glass containing lead. Both the smell and the formation of sulphide of lead point to the presence of a *sulphur-compound*, which had not been entirely destroyed by the boiling with hydrochloric acid (which, it will be remembered, had caused the evolution of some sulphuretted gas). The dilute extract exhibited, moreover, the following reactions:

It was acid to test-paper.

Ferrocyanide of potassium produced a copious white precipitate, which was only partially dissolved by hydrochloric acid, and speedily became blue. The blue colour which the solution at first assumed was due to the presence in it of a *trace of iron*. The increase of the blue colour had to be ascribed to the decomposition which the ferrocyanide always experiences in this reaction (as will be seen, with *zinc*, in the presence of a trace of iron). This white precipitate was not dissolved by the addition of nitric acid, but on heating solution ensued under slight effervescence.

A little of the solution was mixed with its bulk of hydrochloric acid, and ferrocyanide was then added. The bluish-white precipitate was quickly produced.

Ferricyanide of potassium produced a yellowish-red precipitate, of which a part was soluble in hydrochloric acid, denoting the presence of *zinc* and a *trace of copper*.

Ammonia precipitated a colourless matter, partly soluble in an excess of the reagent.

Sulphide of ammonium produced a copious gray precipitate.

The dilute acid extract was now treated with sulphuretted hydrogen until, after violent shaking, it strongly smelled of the gas. A copious gray precipitate fell down. This, after purification, was digested for an hour with warm sulphide of ammonium; but although, after filtration, the solution from yellow had become brownish-red, it extracted no metal from the precipitate, which was still gray. A part of it, dried and incandesced on platinum, left a white residue, not easily soluble in hydrochloric acid, easily soluble in aqua regia; the solution was not precipitated by water, but by ammonia, an excess of which dissolved the deposit entirely. The precipitate having thus been shown to consist of sulphide of zinc only (with the merest trace of iron, to which it owed its gray colour) was heated in a platinum vessel, redissolved in hydrochloric with the addition of a little nitric acid, the solution mixed with water, heated to ebullition, and treated with excess of carbonate of soda, when white *basic carbonate of zinc* fell down as a copious precipitate.

The precipitation of zinc from the acid extract by means of sulphuretted hydrogen made it probable that there was contained in the extract a fixed organic acid, capable of driving out the hydrochloric on evaporation, but having itself only so weak an affinity for zinc in acid solution as to yield it in part, at least, to sulphuretted hydrogen, similar to acetic, lactic, and leucic acids. To isolate such a body the concentrated extract was shaken with repeated portions of ether. The ether was separated, and after distillation left a fluid, which became turbid on cooling, and had a strongly acid reaction; the ether also had an acid reaction after distillation, and the flask in which the distillation had been performed contained a vapour which coloured blue litmus paper red, and gave a white precipitate with silver solution, and was therefore hydrochloric acid. The ethereal extract, evaporated on the water-bath, left a yellowish granular matter, which, under the microscope, also appeared in amorphous granules. It was easily soluble in water, particularly in hot, little soluble in alcohol. It burned with a bluish flame, giving out a smell of burned horn and some aromatic, lastly a cyanic vapour, and left a bulky charcoal, which, though with difficulty consumed, left no residue of a mineral nature. The fluid from which organic matter had been extracted by ether, and which contained all that sulphuretted hydrogen had not precipitated, was saturated with ammonia, and treated with sulphide of ammonium. The precipitate, at first gelatinous and colourless, became green under the influence of the sulphide. It was filtered; the filtrate was greenish yellow. The green precipitate during washing became quite white by oxidation of a trace of iron, and the filtrate of a much paler colour. The deposit was dissolved in hydrochloric acid, and digested for some time, a little nitric acid being added. The solution was neutralized with carbonate of soda, and a slight excess of alkali added; acetic acid was then given to the mixture in excess, when a very slight precipitate of *phosphate of iron* remained. To the filtrate chloride of iron was added until a filtered portion produced a blue stain on paper moistened with ferrocyanide of potassium. The bulky precipitate of white *phosphate of iron*, which did not change colour on heating, was filtered off. The filtrate was treated with a great excess of ammonia, which precipitated all the iron which had been added in excess. The filtrate from the oxide of iron gave a *precipitate* when treated with sulphide of ammonium, which was yellowish, and when heated on platinum decomposed, leaving a gray mass, which did not become white after long exposure to red heat. Treated with nitric acid, it effervesced, dissolved, and on evaporation and heating left a fusible mass. This gradually dried up, and ultimately left a reddish matter. This was easily soluble in hydrochloric acid, and, after heating, formed a colourless solution. After slow evaporation, and the removal of all excess of acid, it became a white residue, which, after solution in hot water and cooling, shot into a mass of fine needles; of these, when separated, a part remained soluble in hot water, another could only be dissolved again by the addition of a trace of acid. In this solution sulphide of ammonium produced a precipitate, which, after washing, was flesh-coloured. A portion treated with peroxide of lead and excess of nitric acid produced a beautiful red solution. The precipitate consisted, consequently, of *sulphide of manganese*.

To the filtrate, which was now free from all substances which could be precipitated by sulphide of ammonium and caustic ammonia, and had been heated to boiling, carbonate of ammonia, with chloride of ammonium and caustic ammonia, was added. A copious white precipitate of *carbonate of lime* fell down. This was the lime which in the gall-stones had been combined with *phosphoric acid*. The filtrate from the lime was treated with phosphate of soda and ammonia; no immediate precipitate ensued. On standing, the fluid remained quite clear, thus showing that no magnesia in combination with phosphoric acid had been precipitated by the sulphide of ammonium.

The filtrate from the first sulphide-of-ammonium precipitate, which, as mentioned, was greenish yellow, was heated to ebullition, and chloride of ammonium, ammonia, and carbonate of ammonia, were added. A bulky white precipitate of *carbonate of lime* ensued, which contained the lime which in the gall-stones had *not* been in combination with phosphoric acid. To the filtrate phosphate of soda and excess of ammonia was given. After twelve hours a deposit of crystals of phosphate of ammonia and *magnesia* had formed. In quantity, this deposit was but a moderate per-centage of the quantity of lime. The magnesia contained in it must be assumed not to have been in combination with phosphoric acid.

First portion of matter deposited by hydrochloric-acid extract on evaporation.—It was dark brown, nearly black. Washed and dried, it became very brittle. Heated in a platinum crucible, it emitted vapours resembling in smell those of impure tyrosine; it then took fire, emitting the smell of cyanogen, and was ultimately consumed, leaving a bulky ash of the shape of the original lumps of matter.

This residue was powdered and heated once more, in order to consume a remnant of carbonaceous matter. It was then treated with hydrochloric acid. The greater part dissolved, but a small amount of black matter remained undissolved.

This latter black residue, on heating, became now white, with a rose-coloured hue; extracted with hydrochloric acid, it yielded up some oxide of iron, and then remained white after exposure to red heat. It assumed a blue colour when heat was applied after a solution of cobalt had been brought in contact with it, and dissolved in caustic potassa; this solution, neutralized with hydrochloric acid, and made alkaline with ammonia, gave a white precipitate. The substance was, therefore, *alumina*.

The acid solution was found to contain the greatest part of the iron which had been present in the gall-stones. It was treated with ammonia and sulphide of ammonium, which produced a black deposit. This, after filtration and washing, was dissolved in dilute, warm, hydrochloric acid. (A trace of residue on the filter, treated with concentrated nitric acid and excess of ammonia, exhibited a vestige of *copper*.) The solution was digested with a little nitric acid. It was then made alkaline with carbonate of soda, a precipitate forming, and again acidified with acetic acid, part of the white precipitate remaining undissolved. This, from the nature of the proceeding, could be nothing else but *phosphate of iron*. The solution, which before had been strongly yellow, now, after removal of the precipitate by filtration, was perfectly colourless. Chloride of iron was now added, and the mixture was heated. A copious precipitate ensued, which became brownish. When the solution, after filtration, gave a blue stain upon paper moistened with ferrocyanide of potassium, all *phosphoric acid* was precipitated in combination with iron. The precipitate was separated by filtration.

To the clear filtrate oxalic acid was given, when a copious white precipitate ensued. This was collected in the usual manner. It contained the *lime*.

To the filtrate from the oxalate, chloride of ammonium, excess of ammonia, and phosphate of soda were added. The walls of the glass were rubbed with the glass rod. After some hours a very slight crystalline precipitate of ammonio-phosphate of *magnesia* had formed.

Second portion of matter deposited from hydrochloric-acid extract on evaporation.—It was collected, washed, and heated to redness, the residue dissolved in hydrochloric acid yielding a brown solution. Sulphuretted hydrogen caused a slight deposit, which contained no copper, and could not be defined any closer. The acid solution was next treated with sulphide of ammonium; the precipitate, coloured green by iron, was, after washing, dissolved in warm, dilute hydrochloric acid, and mixed with the solution of the sulphide-of-ammonium precipitate from the last syrup of the extract. The alkaline filtrate was mixed with the alkaline filtrate of the last extract, and analysed in the manner already described.

The first portion of deposit from the hydrochloric-acid extract contained—

Cholochrome (probably combined with iron, alumina, and lime).
Oxide of iron.
Alumina.
Copper (a vestige).
Phosphate of iron.
Phosphoric acid.
Lime.
Magnesia.

The second portion of deposit contained—

Cholochrome.
Iron.
Phosphate of lime and magnesia.

The remaining extract, after repeated evaporation to dryness, and dispersion of all free hydrochloric acid, contained in solution—

Zinc.
Cholochrome (little).
A new organic body (soluble in ether).
Phosphate of iron.
Phosphoric acid.

Manganese.
Lime (combined with phosphoric acid).
Lime (combined, probably, with cholochrome).
Magnesia (combined probably with cholochrome.)
Ammonium (chloride of).

Alcoholic Extract of Ox Gall-stones.

The alcoholic extract, on cooling, deposits a small quantity of white, granular matter, which is collected on a filter, washed with alcohol, and dried. It consists of cholic acid and cholate of lime in needles, containing some fatty acid not easily separated. The filtrate has the property of ambergris, being amber in reflected and green in transmitted light. It also has a most agreeable odour of musk. After a part of the alcohol has been distilled off, and the fluid has been again allowed to cool, flakes of crystalline matter are deposited. They probably consist of cholesterine. After further evaporation, a biliary acid is deposited in drops—amorphous cholic acid. After prolonged standing, crystals of the same character as those obtained by alcohol from the deposit in rotten ox-bile are deposited—crystallized cholic acid. Most of them are mixed with a syrup, from which they cannot be separated mechanically. This syrup is insoluble in water, and becomes resinous after contact with it; it has all the properties of choloidic acid. This mixture of acids is boiled for a long time with water, which dissolves cholic acid and a light yellow matter, perhaps choloidic acid, though this acid is reported to be quite insoluble in water. However that may be, the watery decoction, when left to spontaneous evaporation, which takes months, owing to the formation of a pellicle on the surface, at last deposits the very characteristic splendid needles of cholic acid, mixed with a granular, brown deposit, which does not give the cholochrome reaction, and may be choloidic acid.

The ingredients of ox gall-stones revealed by the foregoing analyses were the following:

Glycocholate } of soda.
Cholonate }
Salt of resinous acid, related to the foregoing.
Cholic acid, partly combined with lime.
Choloidic acid.
Cholochrome, free and combined.
Traces of cholesterine and fatty acids.
A new organic compound, soluble in ether.
A sulphide, emitting hydrothion with acids.
Lime } as carbonates, phosphates, and in combination with cholochrome and cholic acid.
Magnesia }
Chloride of sodium.
Chloride of ammonium.
A compound ammoniacal base.
A matter having a very repugnant odour, and another having the flavour of musk.
Iron, in the form of oxide and phosphate.
Alumina.
Manganese.
Copper, a vestige.
Zinc, in considerable quantity.

The bulk of the calculi was made up with cholochrome; next in amount were the biliary acids and their salts, then came lime and zinc and the new organic compound. The rest of the ingredients were present only in very small quantities.

Analyses of single Ox Gall-stones.

1. Bolle (Brandes' 'Archiv,' 38, 257. 1839) examined two calculi from oxen. He determined the amount of mineral matter by incineration, and found that the ashes yielded a colourless glass with phosphatic salt before the blowpipe. Destructive distillation of a piece of calculus yielded some ammonia. The colouring matter he found to be soluble in caustic potassa; the solution he perceived to assume an olive-green colour, and subsequently yield a green precipitate. On treatment of the calculi with dilute nitric acid, carbonate of lime was destroyed, phosphate of lime dissolved; some chlorides also entered into the solution. The amount of carbonic acid he determined in a separate experiment.

The first calculus consisted of—

				Grains.
Matters soluble in water, bile, and traces of chloride and phosphate of sodium				1·50
CO_2		1·00	Carbonate of lime	2·28
CaO	5·72	1·28	Carbonate of lime	
		4·44	Phosphate of lime	
PO_5		3·20	Phosphate of lime	7·64
Cholochrome				5·10
Loss				1·98
Total				18·50

The second calculus, after removal of all matters soluble in water, was treated with hydrochloric acid, when it evolved a strong smell of hydrothion, the vapour at the same time discolouring lead paper. This sulphuretted hydrogen Bolle believed to proceed from the decomposition of some sulphide of calcium.

Seven grains of this calculus contained—

	Grains.
Matter soluble in water, bile, traces of phosphate, chloride, and carbonate of sodium	1·12
Lime (determined as gypsum, 0·2)	0·08
Cholochrome	5·78
Hydrothion and loss	0·02
Total	7·00

2. Neukomm (Frerichs, 2, 535). The gall-stone was an elongated, oval, somewhat flattened concretion, between three and four inches long, two inches wide, and one inch thick. Its surface was uneven, tuberculated, and fissured, and of a dirty brown colour. On the surface of a fracture was seen a concentric ring of layers, of a glass-like, brown mass, having the appearance of colophonium, and between its layers was deposited here and there a yellowish-brown powder. Towards the centre of the concretion layers of a white, powdery substance were perceptible.

Chemical examination.—The ethereal extract of a part of the concretion contained crystalline, unsaponified fat, besides free fatty acid, and free biliary acids. Cholesterine was not found.

Spirit of wine and water dissolved a considerable quantity of alkali salts of biliary acids, mixed with chloride of sodium, colouring matters, and free biliary acids. From the concentrated spirit-of-wine solution the latter were precipitated by the addition of water; they were partly amorphous and resinous, partly crystalline. The purified crystals were found to consist of cholic acid.

The following substances were found combined with inorganic bases, and could only be extracted by means of chloroform and spirit after hydrochloric acid had been applied to the powder of the concretion:

Cholepyrrhine in considerable quantity.

Green colouring matter.

Stearic acid, in small quantity.

The hydrochloric-acid solution contained lime, some magnesia, iron, and a small quantity of earthy phosphates.

The considerable residue which was left after these extractions had been completed consisted almost entirely of the particles of glass-like substance which had formed the resinous layers. They swelled a little in water, but did not dissolve; they were quite homogeneous, without organic or crystalline structure; in other respects, they exhibited the properties of proteine compounds.

3. Neukomm ('Frerichs,' 2, 536). A biliary and intestinal concretion from an ox. It was a tuberose body, of a yellowish-white colour, which had much resemblance to a root of rhubarb. On the surface of a fracture layers of vegetable matters, pieces of straw, husks of grain, &c., were perceptible, alternating with layers of a firm yellow, and a white pulverulent matter. Here and there were brownish layers visible.

Under the microscope the matter of the white, chalky, pulverulent layers exhibits groups or entangled masses of needles, which are mostly broken off at one end; the other layers, particularly the yellow ones, show glistening, lumpy masses, besides single needles. A brownish-yellow pigment is deposited diffusively upon some of the lumps, or interspersed between them in granules and irregular pieces.

Chemical analysis obtained the following undoubtedly biliary matters from the concretion:

Cholic acid, in considerable quantity, partly extracted by ether, the greater bulk, however, by alcohol.

Resinous biliary acids, in smaller quantity.

Compounds of cholic acid with lime. They dissolved principally in spirit, much less in water. From the spirituous solution they crystallized in long, pointed needles, which were partly irregularly lying upon each other, partly united in sheaves or bundles. The watery solution deposited these compounds in white crusts on the surface. When dry, the matter was a white, easily friable, and light substance.

The lime-salt of another biliary acid, other than cholic acid, was deposited in microscopic balls, with a dark outline, not rarely imitating the shape of a mulberry.

Both lime compounds were mixed with each other.

Biliary colouring matters were found in small quantities in the ethereal and spirituous extracts.

In the ethereal extract containing cholic acid there were also solid, fatty acids; from spirit they crystallized in scaly groups of crystals.

Cholesterine was vainly searched for.

The small residue of the concretion, which the various extractions had left over contained carbonate of lime, some magnesia, small quantities of phosphates of earths, and rather much iron and alumina; silicic acid was present in the vegetable matter, another part in the form of sand.

4. Wurzer ('Jahrb. d. Chem. und Pharm.', 1829, 3, 625), examined a gall-stone from a cow, and found three quarters of it to consist of the colouring matter of bile. It contained small quantities of the oxides of iron and manganese.

5. Brugnone, "On the Gall-stones of Oxen," ('Ann. Chim.', 86,222, 1813).

6. Gmelin obtained colouring matter from the gall-stone of an ox, and tried several reagents upon it. Among them was nitric acid containing nitrous, which is now recognised as the best reactive for cholochrome in solution.

Gall-stones from the Horse.

Vicq.-d'Azyr, "Mém. sur les pierres biliaries" ('Histoire de la Société royale de Médecine,' 3, 224, 1779), mentions a calculus found in the hepatic duct of a horse, which was presented to the Academy by Poulletier de la Salle. The calculus was brown, lamellated, with thick layers, and its nucleus consisted of a small quantity of blackish bile. Exposed to the flame of a candle, it boiled and swelled up, burned in throwing out a little flame, and left a porous, light charcoal.

Analysis of the Gall-stone of a Sow.

J. L. Lassaigne, "Note on a new kind of Biliary Calculus found in Animals" ('Ann. Chim., 2nd ser., 31, 220, 1826). The animal had been killed in the Veterinary School at Alfort, for anatomical purposes, and contained a concretion in the gall-bladder. The physical nature of the stone is not described, but the chemical analysis is given as follows:

1. Cholesterine	6·0
2. White resin	44·95
3. Bile	3·60
4. Animal matter and green, altered resin	45·45
Total	100·00

It may be conjectured that the white resin was cholic acid. The absence of earthy salts, if not an omission of the analysts, is also a peculiar feature. Both the large quantity of cholic acid and the absence of earthy matter would indicate that this calculus was formed in very acid bile. The presence of cholesterine distinguishes this calculus from those found in the ox and the horse, but the proportion of this substance to the resin is the reverse of that usually found in man—mere biliary resin sinks to a minimum, and cholesterine rises to a large figure.

CHAPTER IV.

ORIGIN AND THEORY OF GALL-STONES.

HUMAN gall-stones mostly contain a resinous, biliary matter, but, owing to the small quantity and the consequent difficulty of isolating it, it cannot easily be identified. The examination of ox gall-stones affords, as we have seen, the means of determining the nature of the biliary matter contained in these concretions. They yield such a large quantity of cholic and choloidic acid as could never be derived from any bile with which the calculi might be supposed to have been soaked at the time they were taken out of the gall-bladder. There can be no doubt that both the cholic and choloidic acids have been deposited, together with the cholochrome, during the pathic process in the living animal.

In human gall-stones these resinous, biliary acids are in the free state; in ox gall-stones a small proportion of them is combined with lime, by far the greatest amount being also in the free state. The cholochrome of human gall-stones, when present in moderate quantity, is almost entirely combined with earthy salts or earths; that of oxen is for the greatest part in the free state. When the amount of cholochrome in human gall-stones exceeds about 10 per cent. of the calculi, it is also present in the free state.

Almost all biliary concretions contain some earthy and alkaline salts, such as phosphate and carbonate of lime and magnesia, or the compounds of these bases with undefined organic acids, with cholochrome, biliary acids, and fatty acids.

Cholochrome, cholic, and choloidic acids, and earthy salts, thus present themselves as substances without the concurrence of which the more common forms of gall-stones would rarely be formed; they are, in other words, essential ingredients of gall-stones. In man, gall-stones contain a large amount of cholesterine in most cases, but that is a secondary ingredient, as the phosphatic crust is of the uric-acid or oxalate-of-lime calculus from the urinary bladder, and is mostly crystallized around the other matters forming the nucleus. There are human gall-stones which, like those from the ox, contain no cholesterine. Others consist almost entirely of cholesterine, with only a slight admixture of biliary salts. Both these classes of calculi are evidently the products of processes which differ materially from the disease producing the ordinary calculi.

In gall-stones from man stearate and palmitate of lime are mostly present; and it remains to be seen how far those substances can assist in effecting the concretion of the detached particles of cholochrome, which I now ascribe to the cholic and choloidic acid. Let us, therefore, dismiss the hypothesis of the inspissated mucus, or the inspissated bile, which figure in our pathogeny as the mortar which combines the particles of the nucleus; mucus is very rarely found in gall-stones, and an inspissation in the midst of fluid bile is quite incomprehensible. Moreover, even an indubitable inspissation of bile could not lead to an insoluble concretion. We may, therefore, reject this hypothesis, and admit that *the binding material of the nucleus of gall-stones is cholic acid, or choloidic acid, or both.*

The process by which gall-stones are formed appears analogous to that which produces that rare description of calculus in the urinary passages—the phosphatic or fusible calculus. It is a decomposition of the bile, akin to putrefaction. The compound amido-acids split up into their constituents, under the influence of a cause which remains to be ascertained, but is probably a putrid ferment absorbed from the intestinal canal. Under the influence of a little acetic acid, formed out of glycocoll and some other new acid produced by the putrefactive change, perhaps valerianic acid, cholochrome, a quantity of cholic acid, and a portion of choloidic acid, together with some salts and a little fat, are deposited. This is the process in the ox, and sometimes in man. But the bile of man differs in this respect from that of the ox, that it contains cholesterine, while that of the ox contains, at the most, only a very small quantity as compared to the other. This cholesterine is dissolved in the taurocholate of soda. But as soon as the acid of this salt is decomposed the cholesterine is set free, crystallizes, and deposits upon any particle that may happen to be within easy distance, in the manner of all crystals, which like to post themselves upon prominent bodies.

The presence of chloride of sodium, iron, copper, and other inorganic matters in gall-stones, has, no doubt, a significance in each case, but a subordinate one. In some gall-stones from the ox, I have again found a sulphurous compound, already observed by Bolle in 1832. When boiled with hydrochloric acid, they gave out vapours which smelt like sulphuretted hydrogen and blackened lead-paper. I collected them in caustic potassa, mixed with some solution of arsenious acid. On subsequent acidification, a yellow, somewhat orange-coloured deposit of a sulphur-compound of arsenic was formed; but after drying, it had become brown and hard, and on sublimation yielded tersulphide of arsenic, besides leaving a quantity of charcoal; thus proving that the gas was a compound of a carbonaceous and a sulphurous body in a volatile form, or a mixture of two analogous substances.

Putrefaction of Bile.

Some large bottles, full of bile, and well stoppered, had been allowed to stand for the period of two years and one year respectively. The bile had assumed a feebly acid reaction, a bright port-wine colour, and had deposited a copious flaky, green and brown deposit, mixed with white, chalk-like particles and greenish crystals. This deposit, on analysis, was found to consist of cholochrome, cholic acid, phosphate of lime and magnesia in dichroic crystals, and mucus. The fluid part of the bile was found to contain principally choloidate of soda, with little cholate, taurine, valerianate, and acetate of soda and ammonia, phosphate of soda, but no glycocoll, nor any glycocholic or taurocholic acid. It was quite clear that the bile had spontaneously undergone a decomposition similar to that which is effected by boiling with acids or alkalies—a decomposition which, in its main features, has already been described by Gorup-Besanez. Glycocholic and taurocholic acids had split respectively into glycocoll, taurine, and cholic acid. The cholate, probably, or some other decomposing substance, had yielded valerianic acid, which had combined with soda, or with ammonia, which latter probably originated in the decomposition of glycocoll. This compound being the amido-acid of acetic acid, no doubt in this process, as in the putrefaction of urine, yielded the acetic acid, which combined with the necessary amount of soda, and precipitated a portion of the cholic acid, while the greater portion of this acid remained in solution combined with soda, and became further metamorphosed into choloidic acid, and perhaps other products of decomposition of an acid nature. The cholochrome had, no doubt, been precipitated by the new acid before cholic acid, as its acid properties are much less pronounced. The port-wine colour of the fluid was probably due to some metamorphosed cholochrome, possibly cholochromic acid, or a derivate. That cholochrome, cholic acid, and crystallized phosphates are precipitated in this process had not been observed by Gorup-Besanez, who had also neither found valerianic acid nor explained the origin of the acetic acid, which he undoubtedly discovered ('Ann. Chem. Pharm.', lix, 129).

Gorup-Besanez extracted also a mixture of fatty acids from putrid bile, among which he believed to have recognised margaric acid. This acid, or its fellow, stearic acid, is a component of the first deposit formed in putrid bile. But, like cholesterine in ox bile, this ingredient is too easily lost sight of, in consequence of the small quantity in which it is present.

When Gorup-Besanez allowed bile to decompose at a temperature of from 25° to 30° R., exposed to the free access of the air for a period of three weeks, he obtained choloidic acid as the principal product of decomposition. When, however, he exposed bile to the air for three months, in a cellar, at a temperature varying between 10° and 12° R., he found cholic acid instead of choloidic. In both cases the decomposed mass had an offensive ammoniacal smell and a marked alkaline reaction. Taking into consideration only one element, viz., that of time, he concluded that choloidic acid was the forerunner of cholic acid; that the latter was produced from the former; that the presence of cholic acid was evidence of a more advanced stage of decomposition than that of choloidic acid. But he omitted to take into consideration the most important circumstance—that the specimen of bile which yielded the cholic acid had been subjected to a much lower temperature than the specimens which yielded the choloidic acid, and had thus been influenced by agencies which, above all others, retard the decomposition of animal matters. His assumption, therefore, while unsupported by any direct proof, is opposed by the argument that we know choloidic acid only as a product of decomposition of cholic acid; that we cannot reproduce cholic from choloidic acid; and, further, by the results of my own investigations, which showed that bile, after one year's and after two years' decomposition, contained principally choloidic acid, a portion of this biliary element only being precipitated in the form of cholic acid. This precipitate, it is but right to conclude, was produced at a time when cholic acid prevailed; for had choloidic acid prevailed at the time of the formation of the new acid (acetic, valerianic, and others), the deposit must have consisted of choloidic acid, or at least contained some choloidic acid, while, in fact, it contained hardly any, or none. No cholic acid remained in solution. On account of these, data, I believe that we must reverse the order of succession assigned to those acids by Gorup-Besanez, giving to cholic acid priority in time, to choloidic acid ultimate supremacy, and ascribing to its break up into the fatty acids above mentioned the destruction of the biliary state.

Bile decomposed at a moderate temperature during nine months was found by Gorup-Besanez to exhibit an acid reaction, due to the presence of acetic acid in a free state. It consequently had the same reaction as the specimens examined by myself. He does not state in what condition the biliary acid was present, which is much to be regretted, as free acetic acid could not be present so long as any cholate or choloidate remained in solution, the acids of which salts, in his analyses, he always precipitated by acetic acid.

Diagram exhibiting the Decomposition of Bile.

First Stage. The bile is neutral or alkaline.

$$\text{Taurocholate of soda yields} \begin{cases} \text{Cholate of soda.} \\ \text{Taurine.} \end{cases}$$

$$\text{Glycocholate of soda yields} \begin{cases} \text{Cholate of soda.} \\ \text{Glycocoll.} \end{cases}$$

$$\left.\begin{array}{l} \text{Margarate (palmitate) and stearate of lime} \\ \text{Phosphate of lime and magnesia} \end{array}\right\} \text{are deposited.}$$

Second Stage. The bile becomes acid by the supervention of a new (valerianic ?) acid, whose origin is undecided.

Cholate of soda deposits cholic acid.
Soda-salt of new acid is formed.
Cholochrome is precipitated; a part only remains dissolved, giving to the fluid a crimson colour.

$$\text{Glycocoll yields} \begin{cases} \text{Acetic acid.} \\ \text{Ammonia.} \end{cases}$$

Third Stage. The bile continues acid.

Cholate of soda is transformed into choloidate. The latter deposits some choloidic acid (?).
Choloidate of soda yields fatty acids, products of decomposition; among them, probably derived from glycocoll, is found acetic acid.

The alkaline condition during the first stage, observed by Gorup-Besanez, occurs only when bile putrefies at a high temperature, so that the mucus undergoes active decomposition, and produces ammoniacal compounds. The bile upon which I operated, at low temperatures, and with moderate access of air, I could not at any time discover to be alkaline. In one case Gorup-Besanez observed the acid reaction to give way to a second alkaline reaction, but did not notice any corresponding essential changes. Owing to these uncertainties, I have not distinguished as stages the neutral, alkaline, acid, and last alkaline conditions. Gorup-Besanez is of opinion that the decomposition of the primary biliary acids is not effected until an acid reaction of the bile appears, because only at that juncture does acetic acid produce a precipitate of cholic or choloidic acid. But this negative test appears to me only relative, because the acids may be decomposed, and yet acetic acid may produce no immediate precipitate, more acetic acid being required to cause a precipitate at the period when the bile is yet neutral or alkaline, and when no adventitious acid has yet taken the edge off the alkaline phosphate of soda which is invariably present in bile, and though not very evident to test-paper, neutralizes some acid before an acid reaction can become established. To the naked eye, the first stage is characterised by the deposition of white granules, partly on the top of the fluid, partly at the bottom, partly against the walls of the vessel, which consist of palmitate, stearate, cholate, and phosphate of lime. All the stages, no doubt, gradually pass into each other; and the above diagram, while considered useful for illustration, must not be considered as an absolute syllabus of a variable process.

Analysis of Putrid Ox Bile.

It is necessary to separate some of the white granules from the fluid, in order to show, by combustion and treatment with acidulated ether, that they contain cholate and palmitate or stearate of lime. The free fatty acid forms an emulsion on boiling with phosphate of soda.

The principal step in the analysis of this fluid is the filtration and separation of the deposit. A bag of twilled calico is best used for that purpose. When the fluid has percolated, the smeary deposit in the bag must be kneaded with cold water, as otherwise it is impossible to wash it. When well washed, it is mixed with boiling alcohol, and boiled with it for some time; it is then again put in the washed calico bag. The filtrate, on cooling, deposits a large quantity of crystallized cholic acid. The mother-liquor, on evaporation, yields little cholic and some choloidic acid. That part of the deposit which boiling alcohol did not dissolve is well washed with alcohol, and extracted with a boiling solution of carbonate of potassa. This solution takes up the whole of the colouring matter, and leaves behind a white mass of coagulated mucus, mixed with greenish crystals of phosphate of lime, which are separated by levigation. From the soda-solution the cholochrome is obtained as the green modification, *cholochloine*, by precipitation with hydrochloric acid.

The deposit, therefore, is made up of stearate and palmitate of lime, cholic and choloidic acid, cholochrome, phosphate of lime in crystals, and mucus.

The port-wine-coloured fluid part of the bile is treated with sulphuric acid in slight excess; a large quantity of choloidic acid is then precipitated as a pitchy mass, which is easily soluble in warm alcohol, and contains but little cholic acid, deposited in crystalline granules after long standing of the alcoholic solution. The excess of sulphuric acid is removed, and any free acid neutralized by boiling the fluid residue with carbonate of baryta. When evaporated, this solution deposits resinous cholic acid (which does not decompose carbonate of baryta), to be extracted by alcohol. The alcohol causes a crystallization on standing with the fluid. The crystals consist of sulphate of soda, phosphate of soda, and taurine, to be separated mechanically, and in the ultimate mother-liquor of the decrystallized substances some triple phosphate is obtained, as also some chloride of ammonium, to be obtained pure by sublimation. The alcohol retains the acetate and valerate of ammonia, which salts, after evaporation of the alcohol, yield their acids on distillation with sulphuric acid. The addition of this latter acid still precipitates some resinous biliary matters.

The fluid part of putrid bile, therefore, contains choloidate of soda, a little cholate, a red colouring matter, taurine, valerate and acetate of ammonia, phosphate of soda, chloride of ammonium, and some other as yet undetermined matters.

Putrefaction and Analysis of Human Bile.

As human bile can only be obtained in quantity from persons who have died from disease, it will not easily afford the materials with which to repeat the experiments instituted with ox-bile, which is fresh, healthy, and normal. Human bile, promiscuously collected in the dead-house, even allowing it to contain the normal ingredients, is mostly vitiated by a large amount of albumen, which enters the gall-bladder by endosmosis during the interval between death and obduction. This albumen coagulates in part during evaporation of such bile on the water-bath, another part remaining dissolved. If, then, such bile be subjected to putrefaction, the process takes place under different conditions, and yields, therefore, different results. This difference mainly consists in the circumstance that the alkaline products of decomposition of albumen either neutralize the acid products of the decomposition of bile, which would precipitate insoluble compounds or dissolve them again should they have been precipitated. Deducting the products of the putrefaction of albumen, the products of the putrefaction of the bile itself are the same as those obtained from ox-bile, although they are in a different form. Human bile is mostly neutral. When dissolved in alcohol, it parts with the mucus and albumen, and the filtrate, after evaporation of the alcohol, leaves a residue, which is entirely soluble in water, and such solution is neutral and not precipitated by oxalic or acetic acid. Sometimes, however, human bile exhibits an acid reaction; this, on similar treatment with alcohol, and re-solution in water of the residue, yields a plastery precipitate of choloidic acid. When complete precipitation has been effected, the filtrate evaporated, and the concentrated fluid treated with alcohol, prismatic crystals of taurine are sometimes obtained. The solution always yields ammonia.

Human bile, which has been allowed to putrefy in a stoppered bottle, emits a horrible odour, is of a reddish-brown colour, and apart from the deposit perfectly clear; it has an acid reaction. With acetic acid it becomes troubled, and deposits a resinous precipitate; but the supernatant fluid remains thick, and does not become clear even on boiling and standing; the addition of hot alcohol resolves the turbidity.

CHAPTER V.

ANATOMY OF GALL-STONE DISEASE.

Calculi in the Liver and Hepatic Ducts.

Some authors, probably bearing in mind the large number of cases on record in literature in which concretions had been found in the bile-ducts traversing the substance of the liver, have expressed the opinion that such calculi were frequent. But when it is remembered that these recorded cases are spread over the medical literature of more than two centuries, the erroneous nature of this opinion is at once apparent. Moreover, the term "frequent," without reference to a standard of comparison, is unmeaning. Henenius and Plater possessed no such standard of comparison, which could have justified their belief that concretions in the liver were frequent, when they admonished their contemporaries to search the liver attentively, as it might hide concretions; their object was to overcome the apathy for anatomical research on a particular subject, and they said, "Gall-stones in the liver are frequent," implying, we must assume—"compared to what you, our contemporaries, believe to be their number." Matthiolus had gone further, and had declared gall-stones in the liver to be more frequent than calculi in the kidneys. This obvious error was corrected by Morgagni and Valsalva.

At the present time it may be said that out of one hundred cases of gall-stone disease, in five only are the calculi deposited in the ramifications of the bile-ducts, which is all the more surprising as many calculi, even those found in the gall-bladder, derive their nucleus from matter which in the first instance was formed and deposited in the finest ramifications of the biliary ducts.

The calculi found in the bile-ducts in the substance of the liver sometimes contain some inspissated bile, which is soluble in water. Bouisson examined six calculi from the liver, and observed considerable quantities of bile in four of them. The two calculi which did not contain any consisted exclusively of a mixture of cholesterine and cholochrome. Pierquin found a calculus of the size of a pigeon's egg in a hard cyst of the liver, which consisted entirely of cholesterine. In a case where Guilbert found the common duct obstructed by a calculus the whole of the bile-ducts of the liver were filled with black, gravelly matter. Other ingredients of the gravel and calculi found in the hepatic ducts, such as cholochrome and altered cholochrome, have already been referred to. With the exception, then, of calculi with prevalence of fatty matter and carbonate of lime, all other varieties of calculi, such as are most commonly found in the gall-bladder, seem to have been encountered in the branches of the bile-ducts.

In a few cases the liver-ducts have been found filled with concretions to such a degree that the tissue of the liver could not be cut through with a scalpel. Such a case has been recorded by Chopart. Another one, in which the substance of the liver was hardened in consequence of the deposition of sandy and calculous matter, has been recorded by Portal. The same author found in the hardened and enlarged liver of a female who had died of jaundice the hepatic duct and the canals leading into it filled with

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"concreted and stony bile," to such a degree that not even the smallest probe could be introduced into any of the tubes.

The formation of these calculi is due to a disease of the bile and a partial obstruction of one or more of the biliary ducts. If any duct, as Bouisson and Fauconneau-Dufresne suppose, were entirely occluded by adhesive inflammation or any other cause, a calculus could not be formed, as is always the case in perfect closure of the biliary passages; the bile would simply collect, and enlarge the duct to a considerable size, but it would then stagnate and regurgitate upon the secreting cells, stop their further action, and by a process of diffusion enter the circulation, so as to produce a low degree of biliosity or a true jaundice. The formation of a calculus in any of the ducts is easily understood by the aid of the following hypothesis. The bile is in a state of putrescence. Every one of its particles as it leaves the liver-cells is decomposed, and precipitates both the cholesterine and cholochrome. The epithelium of the bile-ducts, whether by a failure of nervous influence and of nutritive material (as in the case of the epithelium of the tongue in syncope) or by direct contact with the diseased bile, is mortified and shed; it concretes into masses with the cholochrome and cholesterine and other matters, and assumes or, perhaps, retains the shape of the tubes from the surface of which it was shed. Such a cast either obstructs an entire duct by itself, or a number of casts collect and produce an obstruction. The bile, continuing to collect behind the obstruction, deposits more matter and enlarges the duct throughout, and more particularly at the obstruction, to the extent of letting out a portion of the bile. Every portion of bile, as it passes, leaves an amount of matter deposited upon the obstruction, which thus grows in size, expands the gall-duct in its turn, and is ultimately found in a bag formed by the enlarged gall-duct.

A very instructive case, which may be explained in this manner, was described by Reverhorstius ('Diss. anat. med. de motu bilis circulari ejusque morbis'), and the appearances found in the gall-ducts were represented on an engraved plate, which Coe reproduced and attached to his work as his plate ii. Seven secondary hepatic ducts are there shown to contain each one calculus, in a bag-like enlargement.

Calculi in the gall-ducts are rarely found in cases where there has not been a definable disorder or disease of the liver during life. This was notably the case in the observation of Fauconneau-Dufresne, in which branched calculi were found in the principal ramifications of the hepatic duct of a phthisical patient, who died thirty years old, in the Hôpital de la Charité, in 1831. They were black, and measured four lines or nine millimètres in their greatest diameter (which we must suppose means length). In similar cases the parenchyma of the liver has been found changed, not rarely to the extent of inflammation and purulent destruction.

Concretions are sometimes found in the liver which have had no connection with the gall-ducts, and are consequently not biliary. Such are the concrements found in closed capsules, and the tubular deposits of lime-salts in the interior of the veins. Cruveilhier and other anatomists have described concretions surrounded by fibrous capsules, into which apparently no gall-duct entered, and from which no gall-duct left. In such a case the question whether the concretion is biliary or not has to be decided by chemical analysis. Bouisson found a calculus near the surface of the liver, of the size of a pea, and consisting of carbonate of lime. He therefore judged it not to have been a true biliary calculus. The calculi which Plater found in the liver are not stated by him to have been found in the gall-ducts, as is claimed by Bouisson, Fauconneau-Dufresne, and a number of other authors. They were venous concretions or phlebolithes, "hollow, and filled with black blood," as has already been shown in the remarks on this observation of Plater, which are contained in the "Digest of Historical Literature," pp. 20 and 21.

Sometimes the changes in the tissue of the liver which have preceded or succeeded the formation of calculi in the ducts are so considerable that the concretions are found in places which will not admit of any very reliable explanation. In a case related by Pierquin ('Journal des Progrès,' &c., tom. xvi, No. 252) an extremely hard cyst, with fibrous, thick, almost scirrhous parietes, situated in the middle of various alterations of the liver, contained a calculus of the size of a pigeon's egg, and consisting entirely of cholesterine. Another cyst, exactly similar to the first, contained a calculus of the size of an almond. In the substance of the liver several other pieces of cholesterine were found distributed. These Pierquin assumes to have been parts of a large calculus, which he further supposes to have been broken as if by some violence. He has, however, not brought forward any plausible grounds by which we could be moved to adopt those assumptions.

As a curiosity, it may be noticed that Cruveilhier ('Anat. Path.', livr. xii, p. 5) found some small concretions in a supplementary biliary duct, which communicated with the bile-ducts of the liver, but had no outlet towards the duodenum.

The symptoms of calculi in the biliary ducts are peculiar, not only on account of the disorder of the liver which precedes their formation, but also by the peculiar pain and intermittent fever which they occasion, and which has been termed hepatic colic. They do not necessarily, and, on the contrary, but rarely, give rise to jaundice, a circumstance which strengthens the hypothesis above given of the manner of their formation. If their position affects the outlets of a number of gall-ducts, the absence of jaundice denotes that the flow of bile was only partially obstructed; where the calculi command only the outlets of smaller portions of the liver, without causing jaundice, the same explanation is admissible, together with another, namely, that the obstruction to the flow of bile concerns too small a portion of the liver to cause icteric symptoms in the body generally.

Calculi in the hepatic duct.—The occurrence of calculi in this particular part of the biliary passages is rare, because there are no conditions favorable to their formation; and in case there are any formed they can, as long as they are of moderate size, move on either into the cystic duct or, what is easier, into the common duct. Calculi found in the hepatic duct are mostly large and immovable; during life they proceed with much pain through small distances, or are entirely quiescent. Jaundice and tumefaction of the liver are always observed, but the gall-bladder never increases in size. The following cases have been placed under this category. Andral ('Clin. Méd.', 4, 347) found a small calculus at the junction of the hepatic and common duct, which did not appear to be arrested there by any particular impediment. In another case the same author (349) found the hepatic duct very much dilated and filled with biliary concretions; the cystic and common duct, however, obliterated by thickening of their walls. In the remarkable case so artistically represented by Cruveilhier ('Anat. Path.', livr. xii, p. 5) a number of greenish calculi, cemented together so as to form an irregular mass of the size of the duodenum, filled the enlarged common and hepatic ducts. In the 'Gaz. Méd. de Paris' of December 30th, 1843, there is a notice of an observation said to have been made by Wilson upon a patient in St. George's Hospital. The hepatic duct contained a calculus of the size of a filbert.

If the hepatic duct is completely closed, the consequent dilatation of the parenchymatous hepatic ducts becomes very great. This dilatation makes it possible for gall-stones which are contained in the dilated part to move towards the duodenum without causing much disturbance. In this case the dilatation is, of course, caused by the accumulation of bile; in cases, however, where it is caused by an accumulation of calculi it can, owing to their growth, reach such a degree that the duct bursts and discharges the calculi, either into the abdominal cavity, with fatal effect, or into bags and cavities formed by adhesive inflammation.

The following case, in which the hepatic duct was completely obstructed by a calculus, is peculiar, as being complicated with gall-stones in the parenchyma of the liver, the whole disorder being the consequence of injury to the liver. It is related by B. Voisin, in his 'Mém. sur la physiologie du foie,' Paris, 1853, as follows:—"In 1826 there died, at the Hôpital de la Charité, in the clinique of Professor Chomel, a man, æt. 50, who had a very strong jaundice, of which he had suffered for six months, and which had appeared after a fall in which the right side of the abdomen had been struck. At the autopsy the liver-tissue was found softened and full of calculi. One of the larger calculi closed the hepatic duct. The gall-bladder contained no bile."

Gall-stones in the gall-bladder; circumstances favouring their formation.—The majority of gall-stones are formed in the gall-bladder, even though their nuclei, as in the case which I have related, have originated in the smallest biliary ducts. This frequency is explained by various circumstances which favour concretion, and are as follows.

Supposing that the original putrefactive decomposition of the bile has left a precipitate or a nucleus of casts in the gall-bladder, and assuming, further, that the bile, as it is discharged by the bile-ducts into the gall-bladder, is healthy and uncontaminated, it would, on arrival in the gall-bladder, be mixed with a small portion of decomposed bile, adhering to the nucleus or loose particles precipitated by the original disease. Some time being required for setting up fermentative action, it would here be afforded with the greater effect, as each portion of bile on entering would immediately be subject to the putrefactive influence, so that at the end of a few hours the whole of the contents of the gall-bladder would be decomposed.

The bile thus decomposed remains confined in the closed bag of the gall-bladder, and is, without intermission, slightly agitated, not enough to prevent the deposition of particles, but quite sufficient to cause their agglomeration by means of so plastic a binding material as cholic acid. Cholesterine is deposited upon the nucleus mainly by means of that attraction which bodies with uneven surfaces exercise upon all kinds of crystallizing matter; only in cases where the nucleus cannot be assumed to have been anything else but a crystal of cholesterine, or a tuft of small crystals, has the increase of the calculus to be ascribed to that attraction which one crystal exercises upon another of the same kind, or upon matter of the same nature in solution.

When the gall-bladder contracts, it only ejects the greater part of its contents, for its attachments to the liver clearly show that it never can contract so completely as not to leave any cavity. For this reason deposits of whatever kind are hardly ever evacuated, but remain in the gall-bladder for an indefinite time, even if not converted into a stone by means of a binding material.

Position and shape of calculi in the cyst.—The majority of gall-stones are free in the gall-bladder, and capable of assuming any position. While the body is in the erect position they are mostly in the fundus of the bladder, but by slight movements, such as sudden contractions of the abdominal walls or by changes of posture, principally reclining in bed and by the pressure of a full stomach, they can easily be moved to any part of the gall-bladder. This freedom of movement is materially assisted by their specific gravity, which is very little higher than that of the bile in which they are contained.

The contraction of the gall-bladder, whether it is peristaltic or otherwise, has the effect of creating a current towards the orifice into the cystic duct. In this direction gall-stones are most commonly carried, and the symptoms of their passage begin immediately after they have become fixed in the neck of the gall-bladder or the orifice of the cystic duct. It is not rare to find a calculus in this position at post-mortem examinations. Coe has given an illustrative engraving of such an observation.

The shape of calculi in the gall-bladder depends in part upon their composition, in part upon their number. When a single calculus is contained in the gall-bladder it is mostly globular or oblong or egg-shaped, more rarely irregular. When several calculi are contained in the gall-bladder they exert a friction upon each other, which, no doubt, is mainly caused by the movements of the diaphragm in breathing. This friction is most effective during the period of formation, but affects the calculi in a lesser degree after they are once consolidated. The results are the various shapes of gall-stones referred to under the paragraph on this subject in the chapter devoted to the consideration of physical properties of gall-stones.

Gall-stones in the gall-bladder which become so numerous as to keep closely in their relative positions coalesce not rarely with each other. In this manner the whole of the contents of a closely filled gall-bladder has been known to become united in such a manner as to form one solid mass, of the shape of the gall-bladder. In some cases, as in that of which the preparation is preserved in the museum of the Royal College of Surgeons, the cavity of the gall-bladder was greatly enlarged; in other cases, however, the gall-bladder was diminished in size.

Numerous calculi, fitted against each other by attrition during formation, and entirely filling a contracted, normal-sized, or enlarged gall-bladder, are of frequent occurrence. They may be diagnosed during life by the touch through the relaxed abdominal walls (as in the case of the American, related under the section on the curative effects of Carlsbad), or by the sound on percussion in cases where there is a sufficient amount of bile surrounding them to admit of their free movement, or they may be inspected after having been passed during repeated attacks of gall-stone colic.

Biliary calculi impacted in the walls of the gall-bladder, in pouches or abnormal passages, have been observed in a number of instances. They must be distinguished from a peculiar kind of concretion which is sometimes deposited in the small glands in the walls of the gall-bladder, and which is not derived from the bile.

In a case which came under my observation a biliary calculus was impacted in a pouch of the upper third of the gall-bladder, in such a manner that only a roundish surface projected into the cavity, which was filled with numerous calculi and mortar-like gravel of cholesterine and colouring matter. That side of the gall-bladder in which the calculus was fixed had been firmly united with the duodenum. Several years before his death this patient had passed gall-stones by the bowels after severe and prolonged attacks of colic. From the large amount of adhesive inflammation and the appearances of the duodenum, I concluded that the evacuation of the gall-stones had taken place, at least in part, through an opening formed, by ulceration or sloughing, between the cavity of the bladder and that of the duodenum. The outside of the bladder exhibited a narrow aperture, which led into the pouch containing the gall-stone.

Bouisson remarks that these "framed" calculi, as he terms them, were believed to have been formed in mucous follicles or accidental pouches of the wall of the gall-bladder. He himself believes them "to be formed in folds of the mucous membrane, where bile could easily stagnate, or in follicles (*lacunes*) of the mucous membrane, where the elements of bile, mixed with mucus, concreted into a nucleus, round which afterwards ingredients of bile were deposited." This opinion he bases on two preparations in the museum at Strasburg. In the one the fundus of the biliary vesicle shows a valve-like fold, and underneath it a gall-stone-like (*sic*) deposit. In the second preparation a thick calculus is impacted in the upper part of the gall-bladder, whose walls are here enlarged and much changed in their texture.

Whatever may be the nature of these concretions, the preparations in which they are contained by no means bear out the hypothesis of Bouisson. The calculus of the first preparation, if calculus it can be termed, may have been found in the place where it remained, but can hardly be called impacted. The calculus of the second preparation most probably penetrated the wall of the bladder in the course of some ulceration. Bouisson is quite correct when he speaks of concretions the products of the mucous follicles of the gall-bladder, but he errs in believing them to be biliary; they should be termed *cysto-follicular*.

Already Galeati ('Acta Acad. Scient. Bologn.) found some such small concretions in the glands of the gall-gladder; the orifices of these glands were, however, not visible. In a case observed by Morgagni the orifices of these glands could be seen to be open, and the calculi were visible in the enlarged follicles. Mareschal ('Quelques remarques sur les maladies de la Vésicule,' thèse, 1811) found small black, more or less hard masses within the walls of the gall-bladder. Fauconneau-Dufresne found several masses of black matter, of the size of lentils, deposited in the walls of the gall-bladder of a female aged sixty. The matter had the consistence of wax, and when the spot in which it was deposited was pressed between the fingers it came out of five or six pores in the shape of little worms. The same author observed in the walls of the gall-bladder of a man aged thirty four or five hard, black concretions, of the size of millet-seeds, or a little above; they were visible through the internal membrane, and appeared to be contained in the follicles; the orifices of some of the follicles were indicated by black points, others were not visible.

The composition of these cysto-follicular concretions does not appear to have been inquired into.

It is not easy to confound gall-stones impacted in the wall of the gall-bladder or cysto-follicular concretions with concretions of another kind which have to be described as ossification or, better, calcification of a part of the gall-bladder. But as some authors have thought such a mistake possible, it is well to advert to the means of its prevention.

Concretions due to calcification are mostly the products of the peritoneal part of the gall-bladder; they lie between the muscular and peritoneal coat, and on the free surface appear as white, cartilaginous patches, while they rarely affect the aspect of the inner coat of the gall-bladder. In old and worn-out cattle these ossified plates are not rarely met with.

Bouisson adverts to some human gall-bladders showing this peculiarity which are preserved in the museum at Strasburg. The one exhibits a rather extensive calcification, the other only shows a protuberance between the walls of the bladder which a superficial observer might have mistaken for a gall-stone in the cavity of the gall-bladder.

Changes in the Gall-bladder produced by Calculi.

When gall-stones remain for any length of time in the gall-bladder, they mostly produce some change in its texture. The process by which this is effected is probably the following.

After various attempts at expulsion of the concretions, which may have resulted in the discharge of some of them, the mucous membrane of the vesicle becomes congested and at last inflamed. The inflammation may subside, or recur and subside again at repeated intervals, leaving each time a deposit of formative material between the coats. This material becomes organized, and increases the thickness of the bladder to double, treble, or manifold its normal thickness Such a thickened gall-bladder I found in a case of gall-stone disease of many years' standing. Its connections with all other surrounding parts were such that it had to be dissected out with the greatest care, and yet it remained uncertain whether the dissecting knife had not created artificial divisions. A general accompaniment of thickening is contraction. The concretions in the interior become closely and immovably impacted, and, after a time, the interstices between the calculi being all filled up with new matter, bile ceases to enter the gall-bladder.

Under certain circumstances, which can at present not be defined, the irritation produced by gall-stones causes softening of the mucous membrane and ulceration. As ulceration in the gall-bladder occurs without the presence of calculi, other causes, such as decomposed bile or diseased conditions of the mucous follicles of the gall-bladder, do, no doubt, contribute in producing the effect described. Ulceration once established, it generally leads to perforation of the gall-bladder, but in rare cases only does this perforation take place into the abdominal cavity and produce death. It is more frequently accompanied by adhesive inflammation in the neighbourhood, which agglutinates the gall-bladder to the stomach, the duodenum, or the colon, and makes the formation of an abnormal passage to one or other of the cavities of these viscera possible. Through these apertures gall-stones are discharged, and the disease becomes cured. More rarely a gall-stone settles in the artificial passage thus produced, and, the surrounding parts healing, becomes permanently impacted.

Baillie relates a case in which there existed a narrow canal which united the cavity of the gall-bladder with the cavity of the pyloric end of the stomach. It is, however, yet a question whether this canal was the result of the passage of a gall-stone in that direction. Such an abnormal communication has already been observed by Vesalius, and by him at first been mistaken for the normal bile-duct. The commonest case is an abnormal opening into the duodenum, next into the colon. Gall-stones also leave the gall-bladder through ulcerated openings in the direction of the umbilicus and urachus, to be discharged at the navel or through the urinary passages. When the ulceration takes place upon the side attached to the liver, chronic inflammation and ulceration of the liver is the result; the liver adheres to the peritoneal wall. An abscess forms at last, and points in the right hypochondriac region, where it opens spontaneously or is opened, to discharge a mixture of pus, bile, blood, and gall-stones. Many cases get well; others, in which the destruction is extensive, last for many years, with constant discharge of pus, bile, and gall-stones from fistulous openings. The liver at last becomes almost entirely destroyed, and these unfortunate sufferers sink into a kind of marasmus, which wears their bodies to skeletons and almost entirely destroys their mental faculties. This was the case in a Norfolk farmer, formerly a strong and healthy man. The disease lasted sixteen years, until his death. The case was related to me by a medical friend now dead, the brother-in-law of the unfortunate agriculturist. Bonnet ('Traité théor. et prat. des malad. du foie,' 1841) and Morgagni have mentioned cases where gall-stones made their way to abscesses of the liver. They have, however, not excluded the possibility that these gall-stones were themselves the cause of abscesses of the liver, and passed out with the products of the abscesses.

Atrophy, closure and obsolescence, are other consequences of the irritation produced by gall-stones. The attenuation of the bladder in phthisis is very marked. When ulceration is seated in the neck of the bladder, and involves the aperture of the cystic duct, and heals without leading to any perforation, it produces obliteration of the duct. If the gall-stone had been expelled, and the entire inner surface been in a state of inflammation, the gall-bladder may now become entirely obsolete; that is to say, its cavity may disappear by coalescence of its walls, and the anatomist may find nothing but a lump of hard tissue. If the gall-bladder contained a calculus it will, after the closure of the cystic duct, contract around it, and remain quiescent with its charge for the remainder of life. Such was the case related by Fernelius:—"Some decrepid old man, who was very much inclined to be angry, was after his death found without bile and without gall-bladder, in the seat of which latter a very large calculus had become concreted."

Bouisson (p. 63) mentions a case of obliterated cystic duct, the gall-bladder contracted upon numerous calculi.

Enlargement and dropsy of the gall-bladder, as a consequence of gall-stone disease and closure of the cystic duct, have been frequently observed after death, and during life in many instances been the subject of successful operative interference.

A typical example of this disease is preserved in the museum of the College of Surgeons.

In the case of the Florentine noble related by Vesalius the gall-bladder was of the size of two fists, and in a manner filled with the small variety of gall-stones.

Fungous outgrowths of the inner surface of the gall-bladder in gall-stone disease are mentioned by several authors, without individual instances being given. Andral mentions, as a particular effect of gall-stones, the honeycombed surface of the mucous membrane of the bladder. The belief is hardly to be avoided that this anatomist has mistaken the normal appearance of the inner surface of the gall-bladder, which is minutely honeycombed and as if covered by a network, for a pathological production. The same remark applies to the description given of certain appearances in gall-bladders by Ollivier, of Angers, in the 'Archives générales de Médecine.'

Contents of an enlarged Gall-Bladder containing Gall-stones.

J. F. John ('Schweigger,' 11, 1, 1814). On dissection of a person the cause of whose death was not stated, the gall-bladder was found much enlarged and filled with about six ounces of fluid, in which were gall-stones weighing, in all, twenty grains, two of the concretions being of the size of a filbert, the others smaller, tetraedric, and partially decayed, as if worm-eaten, but polished over the rest of the surface. As bile was not present, the cystic duct had evidently been obstructed for some time, and the gall-bladder had become what is termed dropsical.

The fluid resembled the serum of blood, had the consistence of a solution of albumen, was transparent, almost clear, and of sp. gr. 1040. Exposed to the air, a thin membrane formed upon the surface. Acids, spirits of wine, infusion of galls, produced precipitates in it, and the solutions of metals produced bulky deposits. It had an alkaline reaction, restoring the blue colour of red litmus paper. A rod of glass moistened with hydrochloric acid produced strong nebulæ when approached to the surface of the fluid, which proved that a part, at least, of the free alkali was ammonia.

On boiling, the fluid formed a green, frothy coagulum, which after drying yielded to alcohol a light-green colouring substance. What was left undissolved by the alcohol consisted of albumen.

The fluid from which a portion of the albumen had been removed by boiling continued alkaline, and after concentration produced another precipitate on admixture of alcohol.

The filtrate was evaporated, and when reduced to a small bulk had lost its alkaline reaction, all the alkali having been volatilized. Redissolved in water, this mass gave no reaction with hydrochloric acid and chloride of iron, but precipitated with nitrate of mercury and acetate of lead. The absence of picromel (biliary acid, cholic acid) was determined by the two former reactions.

An ounce of the fluid was evaporated and incinerated, and left 1·5 grain of ash. This yielded to water three quarters of a grain of saline matter, which had an alkaline reaction. Tartaric acid formed regenerated tartar. Nitric acid caused an effervescence in the salt. Its solution yielded precipitates with solutions of silver, baryta, and mercury. The fixed alkali was consequently potassa, combined with carbonic, hydrochloric, sulphuric and phosphoric acid.

The part of the ash insoluble in water dissolved in nitric acid, and consisted of carbonate and phosphate of lime. From the traces of carbonic residue, hydrochloric acid extracted evidences of iron.

Three and a half ounces of fluid, or 1680 grains, contained the following proportions of ingredients.

	Grains.
Water	1659¾
Albumen, dry	4¼
Light-green matter, soluble in alcohol	¼
Gelatinous matter, soluble in water and spirit, with traces of biliary colouring matter	9
Mucus	1½
Ammonia	
Phosphate of lime	
Lime, with a combustible acid	
Iron, traces	5¼
Potassa, traces	
Sulphate and chloride of alkali, in small quantity	
Phosphate of alkali, in larger quantity	
Total	1680 Grains.

Calculi in the Cystic Duct.

As most gall-stones which cause symptoms during life proceed from the gall-bladder, they have to pass the cystic duct. This duct is very narrow, and provided with membranous projections, which imitate the form of a female screw. This is the reason why calculi, when they have once arrived in this part of the duct, proceed but very slowly, cause very violent pain, and do not rarely become immovably fixed. In this latter case the gall-bladder undergoes the changes already indicated. The calculus sometimes becomes so moulded to the shape of the canal, that its substance firmly adheres to the tissue. This was observed by Storck and Flandin ('Bullet. de la Soc. Anat.', No. 41). In some cases, as in that reported by Bogros ('Archiv. gén. de Méd.', v, 204), the calculus causes inflammation of the duct and the tissue immediately surrounding it; pus is deposited, and the peritoneum soon participates in the process by inflammation and formation of adhesions. In a case observed by Jacques ('Lancette Française,' 9 Juillet, 1853) the intestines were inflamed, and showed gangrenous points. In a case observed by Bretonneau the cystic duct itself containing the calculus became gangrenous, and an effusion of bile into the peritoneum caused fatal peritonitis.

These cases are happily rare; commonly the calculi pass through the duct without causing any serious or lasting injury; a dilatation of the duct mostly remains.

It has sometimes been observed that a calculus, after passing into the duct and dilating it, has become arrested, and, instead of passing into the common duct, has returned into the gall-bladder. In some cases this result was due to the narrowing or complete obliteration of the portion of the cystic duct which is nearest to the common duct. Thus, Bouisson treated a man of forty who shortly before his death suffered severely of hepatic colic. On a post-mortem examination the cystic duct was found partially inflamed, obliterated at its entrance into the common duct, and filled with calculi in the part next to the gall-bladder. The neck of the bladder and the bladder itself contained a number of calculi.

Calculi in the Common Duct.

When calculi from the gall-bladder or liver proceed towards the duodenum, they have, of course, to pass through the common duct. In this they experience little resistance until they arrive at the place where the common duct passes obliquely through the membranes of the intestine. There they remain longest, and are most frequently found after death.

Dr. Richardson sent me the liver of a lady who had succumbed to heart-disease and continued vomiting from gall-stones, the existence of which had been diagnosed during life. There were calculi in the gall-bladder, the cystic and the common ducts. A tetrahedral stone in the common duct, just where it joins the hepatic and cystic ducts, had with one of its sharp points torn the posterior wall of the duct and protruded through a longitudinal slit of the size of a small button-hole.

The calculi in this case had not sufficiently obstructed the flow of the bile to cause jaundice, which was, perhaps, to be regretted, as the sharp calculus, which ruptured the common duct, might have moved on in an enlarged bile-duct without causing injury. Injury of this kind is, however, a very rare occurrence.

Calculi may become fixed in the common duct and produce conditions of variable importance. When they are small and not very numerous, they will permit the bile to pass through the spaces between them, and then there will be no jaundice. If the disease of the bile which produced the calculi should continue, or be set up anew, more calculous matter will be deposited upon them, and the bile-duct will undergo a corresponding dilatation, as in the case of Cruveilhier, already mentioned. In this case the bile passed between the surface of the calculous mass and the wall of the dilated duct. In a case observed by Gardanne the bile passed through small canals on the surface of the calculus.

Besides this partial obstruction of the flow of bile by fixed concretions in the common duct, there is observed a temporary obstruction by concretions which are a little movable in the common duct. By some agency or other, such as contraction of the duct, the calculus is driven against the duodenal orifice of the duct, and, closing it, produces jaundice. The duct now becomes dilated, the calculus recedes, allows of the escape of the accumulated bile, and as soon as that is effected the calculus again closes the orifice of the duct.

In other cases the calculus is free in the dilated common duct, and causes ordinarily no obstruction to the flow of bile. But at intervals of longer or shorter duration it is driven against the duodenal aperture, causes the usual symptoms, including jaundice, and, after a time, failing to penetrate the wall of the duodenum, returns again to its former place in the common duct. Sometimes jaundice may persist after the calculus has receded.

Such a case was observed by Briquet, and related by Fauconneau-Dufresne. A man of twenty-five years of age had been ill seven years, when, in the year 1818, he was taken with a violent jaundice, during which he had pains in the liver and vomiting. This condition lasted two years, and was not improved by any treatment. During the next six years he could work, but had an attack of hepatic colic almost every month, which he stopped by causing himself to vomit. In 1826 he became further afflicted with a crural aneurism. The attacks of hepatic colic recurred at shorter intervals, became much longer and more severe, and at last caused the patient's death by exhaustion. On a post-mortem examination the liver was found very large, and in the duodenal end of the common duct there was a calculus of a centimètre in diameter, which could easily be moved to and fro in the duct. This and the hepatic duct were dilated to the extent of admitting the index finger; the cystic duct, however, was obliterated.

The most serious effect of calculi in the common duct is its complete obstruction. Such cases have been observed by many physicians. In the case observed by Duplay the calculus had become adherent to the walls of the duct. In a case observed by Andral, and recorded in his work on clinical medicine, several calculi were contained in the duodenal end of the common duct, and the aperture of the duct, seen from the cavity of the duodenum, was situated in a hollow, which reminded the anatomist of the appearance of the anus.

Calculi closing the common duct may become the instigators of ulceration in the duct; in a few cases the biliary passages contained a fluid mixed with much pus. The stagnation of the bile and its accumulation in the gall-ducts and gall-bladder produces great dilatation of these cavities, a chronic enlargement of the liver passing sometimes into atrophy, and incurable jaundice.

Number of Calculi sometimes found in the Gall-bladder and Ducts.

The pellucid or pure cholesterine calculus is mostly solitary. The cholochrome calculi, particularly those of the ox, have also little tendency to multiplicity. Most common is the occurrence of from two to ten gall-stones in a gall-bladder. Not only the mixed calculi, with prevalence of cholesterine, occur in large numbers, but also the calculi with prevalence of altered cholochrome, or rather that variety of them which might be termed pepper-corn concretions. Of the former, almost any number up to 7802 has been counted. Paré found 1600, Grasecius upwards of 1000, Hunter 1100, Starck 2000, Tasch and Meckel upwards of 3000, Burseus 2646. The number of 7802 was observed by Otto, and recorded in his work on morbid anatomy. Bouisson, in one of his cases, counted 1450 gall-stones.

The more numerous these concretions are, the smaller is generally their size. At last they cease to appear as typical calculi, and partake of the character of a promiscuous precipitate, without any arrangement of layers round a nucleus. In that case the deposit constitutes biliary gravel.

Gall-stones found in various parts of the Intestinal Canal.

The most frequent fate of gall-stones is their expulsion through the intestinal canal. This they enter either by the enlarged common duct or by new and abnormal passages, such as have been described in a former paragraph. It is yet an open question whether or not gall-stones can be formed originally in the intestinal canal. On general grounds, the possibility cannot exactly be denied, although the great activity of the intestinal tube, the constant presence of a large amount of strange materials, and the chemical nature of the secretion of the intestinal canal, make the occurrence very improbable.

Rubini (in his 'Pensieri sulla varia origine e natura de' corpi calcolosi che vengono tavolta espulsi del tubo gastrico,' Verona, 1808) has divided the calculi which are found in the intestinal canal in three classes:—1. Biliary concretions. 2. Biliary concretions, with a secondary deposit formed in the intestinal canal. 3. Intestinal concretions. It follows from this that a calculus found in the intestinal canal, although offering the external signs of a true intestinal stone, cannot be pronounced such before its structure has been examined by a section, and its composition by chemical analysis.

The salts which may become deposited upon a biliary calculus are the same as those constituting ordinary intestinal calculi, viz., phosphates of lime and magnesia, with ammonia and carbonate of lime. Impurities are not rarely present.

Concretions of solid fat, said by Mojon ('Révue méd.', 1844) to occur in the fæces, and to be producible by the habitual use of sweet oils, are not liable to be mistaken for either gall or intestinal calculi.

The *symptoms* which gall-stones produce when they have arrived in the intestinal canal are of great importance in a practical point of view, as proper treatment may in severe cases not rarely avert death, and assist in the discharge of the calculus.

A common effect is retro-peristaltic action, from closure of the intestinal canal. The violent vomiting excited under these circumstances has the effect of—conjointly with the reversed muscular action of the digestive tube—propelling the calculus upwards through the pylorus into the stomach, where it may remain longer or shorter, to be evacuated by vomiting. Of such cases we have in the historical introduction, and under other paragraphs, given examples.

The temporary presence alone of gall-stones in the intestinal canal may cause vomiting, without the calculus being propelled upwards and thrown into the stomach.

The most frequent course which gall-stones take is their exit by the anus, alone or accompanied by fæces; and if their passage into the intestinal canal has been preceded by a prolonged closure of the common duct, accompanied by much biliary colouring matter in fluid stools; they mostly retain their shape, but sometimes are broken, and found in fragments dispersed in the fæces.

Calculi of larger size become now and then fixed in the intestinal canal, and cause serious symptoms, not rarely death. Vater (Haller, 'Diss.', 7, 714) and Bezold (Haller, 'Diss.', 3, 605) have observed such calculi, and treated of them at some length. Another case is related by W. H. Partridge in the 'Provincial Med. Journal.' (See the 'Lancet,' Feb. 17th, 1849, p. 210, where the following particulars are given) :—" An old gentleman, aged seventy-eight, tall and thin, and of good general health, was attacked by jaundice and frequent vomiting, and had severe, fixed pain in the region of the gall-bladder. The attack lasted three weeks, after which some amendment took place, and, ultimately, bile was passed by the bowels. Two months afterwards, obstinate and insuperable constipation came on, accompanied by vomiting of stercoraceous matter, followed in a few days by exhaustion and death.

" On making a post-mortem examination, all the parts in the neighbourhood of the gall-bladder, the pyloric end of the stomach, duodenum, pancreas, and colon, were closely and firmly adherent to each other and to the concave surface of the liver. No trace of the gall-bladder could be discovered. A large biliary concretion was found in the lower part of the ileum, a little above the cæcal valve, and, though but loosely embraced by the gut, was manifestly sufficient to account for the fatal obstruction. In figure, it was somewhat pyriform, and exactly resembling the gall-bladder, having also a curved, tapering process, corresponding to the cystic duct; in length, it measured three inches and a half; in circumference of its large portion, four inches. The texture was tight; weight, seven drachms and one scruple."

Biliary calculi which have arrived in the processus vermiformis or one of the diverticles of the colon may become stationary there, without causing much uneasiness or disease.

CHAPTER VI.

PATHOLOGY AND TREATMENT OF GALL-STONE DISEASE.

Gall-stones in new-born Children.

Gall-stones can form only during those periods of fœtal life which succeed the perfection of the liver and first secretion of bile. As before the seventh month of fœtal life the bile does not enter the gall-bladder, gall-stones in this latter organ can only form during the last two months of intra-uterine existence.

Valleix ('Clin. des Malad. des Enfants nouveau-nés,' Paris, 1838, p. 316) found in three cases the bile in the gall-bladder to contain numerous small, blackish, hard grains; in one case they were of the size of pins' heads; in the two other cases they were much smaller; none were analysed. The passage of bile into the intestine was in no case interfered with.

Bouisson (p. 48) gives the following case. A new-born child died under the symptoms of the highest degree of icterus. On dissection, all tissues and fluids, without exception, were tinged yellow. The gall-bladder contained three calculi. The bile was thick and black, and the ductus choledochus exhibited a beginning occlusion.

The case in which Cruveilhier ('Anat. path.', 12e livr., pl. iv, fig. 2) found concretions in the liver of a new-born child is evidently not an example of ordinary gall-stone disease. The concretions in this case probably consisted of inspissated bile and tuberculous matter, and were contained in cysts which in no case had any connection with bile-ducts. Cruveilhier nevertheless believes the cysts to be remnants and dilatations of inflamed and diseased bile-ducts.

Soemmering asserts that Valentinus had observed concretions of the size of peas in the gall-bladder of an infant—" in vesicula fellea infantis pisi magnitudine concrementa vidit." The passage of Valentinus (Professor at Giessen, about 1700, in his ' Polychrestorum exoticorum disput.', iii, p. 42) runs, however, as follows :—" In folliculo biliario infanticidæ . . . publice dissectæ tales (sc. calculi) pisi magnitudine observati sunt."

Bouisson (p. 48) refers to observations of Lieutaud as samples of the occurrence of gall-stones in new-born children. I have searched the cases which Lieutaud (in his ' Hist. Anat. Med.', edit. by Portal, i, observ. 861 to 906) has collected, and not been able to find any cases of gall-stones in children amongst them. Platner (' Bouisson,' p. 48, footnote) says that Straub (in his ' Diss. de calculis biliariis,' Mogunt., 1792, p. 20) had related two cases of small children or infants in which gall-stones had been observed. As Straub's dissertation was written under the presidency of Soemmering, only three years before the latter author's own treatise on the subject saw the light, and as Soemmering has only two references to gall-stones in children, one the error regarding the statements of Valentinus already cleared up, and another originally published in the ' Edinb. Med. Essays,' the case of a boy nearly thirteen years old, I have much reason to doubt the correctness of Platner's reference, and regret not to have been able to inspect the dissertation of Straub.

Fauconneau-Dufresne, in his statistical paragraph on gall-stones (loc. cit., p. 239 et suiv.), has referred to four cases of gall-stones in new-born children as a portion of his entire number of ninety-one cases. These four cases probably were the same as those I have quoted above from Valleix and Bouisson.

Gall-stones in Children.

Among the older physicians Hoffmann, among the modern ones Guersant, have declared that, during a practice of many years, they had never observed gall-stones in children. And if the singular examples which I shall have to relate hereafter prove this rule not to be absolute, it is still general enough to be looked upon as most remarkable, and invites to an inquiry into the circumstances by which it is sustained.

The food of the sucking animal is of a simple and, to some degree, unalterable nature. Its supply is limited by the source whence it is drawn; even if an excess should be available and be partaken of, this superfluity is easily rejected by the young child by virtue of the facility of vomiting, which it owes to natural arrangements of a mechanical nature, namely, the shape of the stomach, particularly the absence of the cardia. The child is thus protected against all the evil consequences of over-feeding; its digestion is always rapid; a large amount of fluid is always available, and the juices of all the organs, the blood, and the secretions, are always sufficiently diluted; as a general result of these circumstances, it may be stated that children at the breast are generally free from that class of digestive derangements of which, in the shape of indigestion and constipation, the later years of life are so fertile.

The simplicity of the food and the amount of the exercise taken during childhood and adolescence continue, to a great extent in furnishing the conditions which protect the child from the disease which produces gall-stones. When children take an excess of food, or food of an unwholesome nature, the reaction of their intestines is mostly decided and rapid, and shows itself in spontaneous vomiting and purging. In this manner are prevented those loaded conditions of the intestines, in which the digestive fluids struggle in vain to overwhelm the corrupt mass of putrefying material which gluttony has heaped within the living structures : in the young, the mere excess of bulk causes their entire rejection ; in the adult, on the contrary, whose organs have become patient by frequent repetition of injury, putridity corrupts the whole system, and first and most lastingly the liver, and the product of its secretory activity, the bile.

Looking back again from the adult upon the fœtus in utero, we find there conditions of a similar kind, namely, intestines loaded with excrementitious matter, which, when disturbed by a slight, external impulse, can be imagined to become the result of such fermentation as might lead to the production of gall-stones. This may in some measure account for the greater liability to gall-stones of the fœtus over that of the child during the first ten years of its life.

In the following remarkable case injury was the primary cause of the gall-disease.

Gall-stones obstructing the common duct; great enlargement of gall-bladder; white fæces without jaundice; death. (J. Gibson, in 'Med. Essays and Obs.' ii, obs. 30.)

A boy, æt. 12, of a healthy habit, in October 1721, fell from a wall three yards high across an old tree, on which his right side struck, and he immediately complained of an acute pain all over the bastard ribs of that side; but by repeated bloodletting it decreased into an obtuse, heavy one. After some months he was observed to grow lean, to eat little, and to be less fond of diversions than usual. He went to the country, was put upon a diet of whey, with riding on horseback, and returned to town without any other complaint than a little weight or weariness in both his sides upon violent exercise. However, he soon began to complain again of the pain in his right side, had lost flesh and colour, and had become exceedingly slothful. A few weeks later he suffered constant pain in his stomach, vomited often, drank much, had his tongue parched, his skin dry and hot; his pulse was frequent and feeble; his urine crude, and in small quantity; his belly very costive, and what excrements he voided were white; he breathed quick; his legs pitted towards the evening; and a hard, circumscribed swelling began to appear in his right side, and, increasing daily, stretched itself over the scrobiculus cordis to the left hypochondrium, raising the under part of the sternum and forcing outwards the false ribs of both sides.

Thirteen months after his fall his legs, thighs, and belly were constantly swollen. Five months later the abdomen was felt fluctuating. The symptoms increasing daily, he begged to be tapped. The operation was performed by Gibson, and near three Scots pints, or twelve pounds, of water were drawn off by the trocar. The water had a greenish hue and a gross sediment of the same colour. The lower part of his belly subsided to very near its natural dimensions after this evacuation, but its superior part did not in the least diminish. He died the second day after the operation. Two days afterwards his body was inspected, and the following found.

The omentum was emaciated, and adhered firmly to the intestines, so that it could scarcely be separated without tearing. The stomach was rather less than ordinary, and was pressed by the gall-bladder and spleen into an oblong form, not much unlike the cæcum. The intestines and other viscera of the abdomen (the liver, gall-bladder, and spleen excepted) appeared almost as usual, only more tender.

The liver was not much bigger than ordinary, but its convex part adhered so intimately to the diagraphm that it was impossible to separate them without the help of the knife. When this viscus was cut a great number of spherical tubercles, about the bigness of a common bean, appeared in its substance. They had no vessels either entering or going out from them, and seemed only to be set loose in the substance of the liver.

The gall-bladder was continuous to all the concave part of the liver, and was extended to a most surprising bulk; for it contained no less than two Scots pints, or eight pounds, of bile, rather thicker than the cystic generally is, and of which several concentric bags, enclosed one within another, were formed; these had all the internal figure of the gall-bladder, and differed from each other only in this, that those which were next to the vesica were firmer and more opaque, while the more internal were of a lighter green colour and of a more tender substance.

The ductus communis choledochus was larger than usual, and was filled with many small, spongy stones, of a yellowish hue, that swam in water.

The spleen was natural in its substance; it was united with the diaphragm by false membranes, forming a cyst, containing three Scots chopins, or six pounds, of clear serum, without smell, but exceedingly salt, and not coagulable. A small lobe of the liver went from its lower edge under the stomach and terminated membranous into the cystis of the spleen.

This case is remarkable in many respects, but particularly in this that the boy had no icteric symptoms, notwithstanding the bile was prevented from passing into the duodenum by stones lodged in the common duct.

Coe (l. c., p. 67) shortly refers to this case, and adds (p. 68) that he had "heard from a person of undoubted credit of gall-stones having been found in the gall-bladder of a child much younger than that boy."

Wolff (Virchow's 'Archiv,' 20, 1) mentions the case of a boy of ten years of age, which occurred in the practice of his father. The boy expelled some calculi by the intestinal canal, and recovered his health. Amongst forty-five cases of gall-stones disease observed by Wolff upon living persons during a practice extending over forty-three years this was the only one in which the age of the patient was below twenty years.

Portal ('Maladies du Foie,' p. 325) observed several concretions in the hepatic ducts, and one in the common duct of a child, which died on the twenty-fifth day of an attack of jaundice.

The same author mentions two cases of a similar nature.

Frerichs ('Clin. of Dis. of the Liver,' p. 510) says that the youngest individual with gall-stones that had come under his notice was a girl seven years of age, who, after an attack of disease of the hip-joint, had been attacked with waxy degeneration of the liver, spleen, and kidneys.

Frequency of Gall-stones.

The question about the number of persons, members of a community subject to a census, who suffer from gall-stones, cannot, I fear, be answered. Assertions, therefore, concerning the frequency of gall-stone patients, the prevalence of gall-stone disease in certain districts, among certain classes, at certain times, must be received with great reservation.

A physician, who during forty years had been engaged in a most active practice, had made notes of nearly eighty cases in which he was consulted or found calculi after death.

Wolff (Virchow's 'Archiv,' 20, 1) observed forty-five cases of gall-stone disease in living persons during a practice extending over forty-three years.

Haller ('Opusc. pathol.', p. 77) relates that, out of 230 bodies dissected in the anatomical theatre at Göttingen, two only had stone in the urinary bladder, but in fourteen biliary calculi were found.

Relative Age of Persons affected with Gall-stones.

The question concerning the relative age of persons found suffering from gall-stones is of practical importance, by its bearing upon the etiology of the disease. In so far as habits are entailed by certain ages, age may be said to be a predisposing cause of gall-stones. We have seen the age which enjoys an almost perfect immunity from the disease; let us now inquire which age is most liable to it.

Walter ('Observ. anat. Concrementa terrestria,' 1775, and 'Mus. anat.', t. iii, Berol., 1803) has inquired about the age of 91 patients of both sexes, and found that none were under twenty years old; 1 was twenty; 27 were between thirty and forty years of age; 14 between forty and fifty; 19 between fifty and sixty; 8 between sixty and seventy; 13 between seventy and eighty; 1 was eighty, another ninety; uncertain was the age of seven. Of these 91 cases two thirds belonged to the middle and after period of life, the years thirty to sixty.

Hein ('Henle and Pfeufer,' 4, 293) examined 395 cases, and of these only 15 were persons below twenty-five years of age, while only 3 were below twenty. The three latter cases were those of two girls of seventeen and eighteen and of a boy of sixteen.

The inquiries of Fauconneau-Dufresne (loc. cit., p. 239 et seq.) extend over 91 cases. Amongst these there were 4 cases of gall-stones in new-born children; 6 cases were below twenty-five years; 13 between twenty-five and forty; and 68 between forty and eighty years.

Of the 45 cases of Wolff (Virchow's 'Archiv,' 20, 1) the majority were of middle age, but there were among them a boy of ten years and two young men of twenty and twenty-two.

The above data are not sufficiently numerous to justify general conclusions. They moreover require correction for the relative number of persons of the relative ages living at one and the same time. As a lesser number of persons of high age is living than of middle-aged people, the prevalence of gall-stones in aged people will, after the correction indicated, appear greater than in the above proportions.

Table showing frequency of Gall-stones at different Ages.

Age in years.	Number of cases.			
	Walter.	Hein.	Fauconneau-Dufresne.	Wolff.
New-born	—	—	4	—
1—10	—	—	—	1
10—15	—	—	—	—
15—20	1	3	6	—
20—25	—	15		2
25—30	—	377	13	42
30—35	27			
35—40				
40—45	14		68	
45—50				
50—55	19			
55—60				
60—65	8			
65—70				
70—75	13			
75—80				
80—85	1		—	—
85—90	1		—	—
Uncertain	7	—	—	—
Total .	91	395	91	45

Influence of Sex upon the formation and nature of Gall-stones.

Morgagni compared a great number of cases, and came to the conclusion that these concretions are almost as common amongst men as amongst women.

It nevertheless became a current opinion that women were more subject to gall-stone disease than men. This belief was first decidedly expressed by Ch. Etienne ('De dissect. part. corp. hum.', lib. iii, cap. 42), and was adopted and defended by Fr. Hoffmann ('De bile medicina et veneno corporis,' Hallæ, 1704), Haller ('Elementa physiologica,' Lausannæ, 1777), and Soemmering. The latter believed to have found out that women were particularly liable to gall-stone disease during the climacteric period.

Of the 91 cases examined by Walter the majority, namely, 47, belong to the male sex, and only 44 were females. For practical conclusions, these proportions may be considered equal. Women of from thirty to forty years of age seemed more liable to the disease than those females who were either below or above that age.

Out of 45 cases observed by Wolff (l. c., p. 1) 15 were males and 30 females, giving a proportion of 1 to 2.

Out of 620 cases analysed by Hein 243 were males and 377 females, making a proportion of about 2 to 3.

Table showing frequency of Gall-stones in both Sexes.

Observers.	Total.	Male.	Female.	M. to F. proportion.
Walter	91	47	44	1 : 1
Hein	620	243	377	2 : 3
Wolff	45	15	30	1 : 2

Individual and hereditary predisposition as alleged causes of Gall-stones.

In persons who were believed to be subject to a periodical formation of gall-stones, an *individual predisposition* has been assumed. Apart from the impossibility of determining whether a gall-bladder which once contained gall-stones has been completely emptied, the recurrence of gall-stone disease would not by any means be explained by such expressions. Relapses in gall-stone disease, if they really occur, do not admit of explanation by generalities, but are best interpreted as new diseases, having no connection with the primary attack.

Bouisson speaks of an *hereditary predisposition*, without adducing any data to prove that the disease is ever inherited. In two cases out of the forty-five collated by Wolff one of the parents of the patient had suffered similarly. It is said that the formation of gall-stones in such cases of hereditary predisposition cannot be prevented by the strictest measures and the avoidance of all that favours the formation of gall-stones. But as Bouisson has not stated the measures which prevent the formation of gall-stones, or the causes which produce them, the assertion is simply idle. Of similar merit is the assertion that in these cases of hereditary predisposition the secretion of bile underwent a change, by yielding more pigment and cholesterine, and an excess of salts, which under ordinary circumstances occurred but sparingly in the liver. The bilious temperament, says Bouisson, further, can be considered as the first degree of such a predisposition; at least, it occurs in very many persons afflicted with gall-stones. If the bilious temperament admitted of a definition, its claim to be considered as a predisposing cause to gall-stones might here be considered. It is, however, to be feared that the bilious temperament of gall-stone patients is not a cause, but an effect, of their disorder, and until this doubt is removed we have a right to dismiss as untenable the above proposition.

Obesity an alleged cause of Gall-stones.

As very fat persons were sometimes found harbouring these concretions, the idea of a connection between the two disorders took ground. It gained in strength when cholesterine was believed to be a fat, and its deposition in the biliary passages was ascribed to the presence of an excess of this substance (which, together with an excess of pigment and other salts, characterised the "hereditary predisposition" of Bouisson). With the knowledge that cholesterine was an alcohol, not proved to have been present in excess, and deposited in consequence of the decomposition of its solvent—taurocholic acid—this imaginary connection ceased to be of the least weight, and the opinions of Durande and of L'Héritier ('Traité de chim. pathol.', 1842), opposed as they already were by the investigations of Benkoe, lost all ground.

Sedentary Habits, Sleep, Rest, and Imprisonment, as alleged causes of Gall-stones.

That persons of sedentary habits, such as authors, or women following callings which entail little exercise of the body, are more liable to gall-stones than other persons of active habits, has been alleged, but not proved. So far as my own experience goes, active habits, on the one hand, do give no protection from gall-stones, if they are not joined with moderate habits of living; and sedentary habits, if not accompanied by excesses in eating and drinking, do not by any means predispose to gall-stones. Among the cases I have adduced I may here refer to that of an habitual sportsman, who was daily on horseback, a free liver, and who became afflicted with biliary calculi, all of which he passed, and recovered. A very active teacher of music, who, at the same time, was a most moderate liver, became the subject of the disease in question, and though it did not prevent him from reaching an age exceeding eighty years, nevertheless it embittered the last years of his life. A medical gentleman in a sea-coast town ascribed his gall-stones to over-exertion during an epidemic of cholera. In many cases neither want of exercise nor over-exertion can be accused of being at the bottom of the disease.

In the forty-five cases collated by Wolff sedentary habits could not be blamed for the disease, as most patients were of very active habits.

Imprisonment.—Soemmering states that he found gall-stones in the bodies of most females and males who died in the prisons of Mayence and Cassel. Bouisson also found them not rarely in the bodies of prisoners at Nismes and Montpellier, but not so often as had been stated by Soemmering. Besides these general statements, no data are in existence upon which to found any positive assertion, and, consequently, we are obliged to reject the hypothesis that imprisonment is favorable to the development of gall-stones.

Long-sleeping.—Hoffmann, Van Swieten, and Haller have accused long-sleeping as causes of gall-stones. The hypothesis is not without a reasonable amount of support in one sense; calculous disease, putrefaction of bile, might exist without being due to long-sleeping, but this excessive rest might afford the opportunity for the settlement of any precipitate in the gall-bladder or ducts, which precipitate in an active condition of the body would have been carried out of the biliary passages altogether. On the other hand, a short sleep of six or seven hours seems to afford ample time for the deposition of any precipitate. Besides, the proposition is not countenanced by any experience.

Coe attributes great influence to the compression of the intestines by a full meal. In so far as the meal is objected to as something that compresses mechanically, it seems to deserve but little attention; but the full meal itself, as an unmanageable and easily fermenting mass, is, no doubt, a breeding-ground for the ferment of which gall-stone disease is the product. Coe, therefore, while appreciating the cause itself, seems not to have understood the manner of its action.

Complication of Gall-stone Disease with other Diseases.

(*a*) *Marasmus of Age.*

Samuel Cooper drew attention to the frequent occurrence of gall-stones in bedridden persons. To some extent I can confirm this statement, but it lacks the confirmation of comparisons by figures. The dissecting-room, which receives the unclaimed dead of the workhouse infirmary, not rarely yields a crop of calculi in the gall-bladder. Thus, I found a number of small, dark-green calculi in the gall-bladder of an old man who had died of mollities ossium, many fractures and contortions of bones being found upon his body. An aged woman, emaciated to the last degree, had one brown, soft gall-stone in her gall-bladder, besides a large hydatid cyst in the liver.

(*b*) *Phthisis of the Lungs.*

Calculi are frequently found in the gall-bladders of persons dead of consumption of the lungs. A connection between both diseases has been inquired after, but, besides hypotheses, no result has been obtained. It must be remembered that consumption is a very frequent cause of death, frequently inquired into anatomically, so that even if gall-stones were an accidental occurrence, and not a connected complication in consumption, they would frequently be met with by the anatomist. Nevertheless, I believe that in a proportion of cases of phthisis, particularly tubercular phthisis, gall-stone disease is a connected complication, and may precede, accompany, or supervene upon the development of the lung disease.

1. *Gall-stone disease precedes phthisis.*—In this place I

must allude to a case which exhibited a tendency to bilious attacks. Fever, coated tongue, yellow conjunctivæ, indigestion, and constipation, were the symptoms. Blue pill was largely used, contrary to my remonstrance, or before I was called into action. After purging and a period of weakness, the patient recovered, but was left much weaker than before. A coherent treatment had some effect. A return to business and some years of indifferent health ensued, until at last a certain pallor of the countenance and a clarionet-sound of the voice appeared as evil omens. One morning the patient was taken with hæmoptysis, which brought him to the verge of the grave. During the last years continued gall-stone pains leave no doubt of the formation of these concretions, which will probably remain in the seat of their formation until the natural solution of the malady.

2. *Gall-stone disease accompanies phthisis.*—A case of this kind offers no particular symptoms; after death from phthisis one or many gall-stones are found. By a calculation of the probable duration of the disease in the biliary passages, a comparison with the known duration of the lung disease becomes possible, so that the biliary disease may be said to be of equal duration with the pulmonary.

In a man dead from phthisis I found a white, round cholesterine calculus, without any admixture of cholochrome.

Mr. Rogers Harrison brought a case before the Medical Society of London, in which, on dissection of the body of a young man who had died from consumption, the gall-bladder was found filled with many hundreds of gall-stones of various sizes, white outside, from finely deposited cholesterine, not chalk, as had been believed from appearances, and containing a darker nucleus. Evidently bile had not entered the gall-bladder for a long time.

3. *Gall-stone disease supervenes upon phthisis.*—This may be the case in any stage, but is more commonly so in the hectic stage, or during a colliquation which becomes arrested and is followed by considerable improvement. In these cases, several hypotheses may be resorted to for an explanation. The disease of the intestinal canal, which many physicians assert is the consequence of the swallowing of the sputa, particularly of those which the patient during sleep fails to reject, may yield sufficient fermentative matter to kindle a diseased process in the liver. Or the blood may be poisoned by absorption of matter from the diseased parts of the lungs themselves, and may infect the liver, so as to dispose its secretion to an analogous decomposition. The liver is a favorite depository of pyæmic poison, and a breeding-place for its progeny. These speculations are, however, not capable of any very striking support by experiment or observation. They have, therefore, no greater value than that of suggestions for future inquiry.

Climate an alleged cause of Gall-stones.

Haller, based apparently upon the statistics of his dissecting-room, accused the climate of Göttingen of fostering gall-stone disease, but imparting, as a recompense for this infliction upon the inhabitants of this university town, a great immunity from urinary calculi. The century which has meanwhile elapsed has left the climate of Göttingen what it was in the time of Haller, but the proneness to gall-stones and the protection from urinary stones have both disappeared. Now-a-days the Göttingen people are not more subject to gall-stones than the people of other continental towns.

Brugmans has enlarged the statement of Haller, by expressing his belief that the people of the kingdom of

Hanover were more subject to gall-stones than the neighbouring Dutchmen. But he has not brought any evidence of his proposition, so that it must be considered as unfounded.

Statements of the prevalence of gall-stones in towns and districts must, however, be always received with caution and respect, for this reason—that gall-stone disease may be epidemic amongst men, as it has been positively asserted to be now and then epidemic among horses and cattle. Both Haller and Brugmans may, therefore, have been right for their time, and cannot be judged absolutely by subsequent experience or present inquiry. Diseases which ordinarily are sporadic have been known to become epidemic. Diabetes has been epidemic (as Dr. Cockle stated from P. Frank and other writers, in his paper on that disease read before the Medical Society of London); goitre has been epidemic for a twelvemonth in a town in this country. The strangeness of an assertion of this kind challenges double vigilance on the part of the true follower of science.

Naumann ('Med. Clinik,' 5, 341) has alluded to some regions of Lower Germany and Hungary as particularly favorable to the production of gall-stone disease. His assertion is much too general to deserve more than notice in this place.

As a curiosity, deserves to be noticed the announcement with which the 'Morning Chronicle' of London (No. 5894) once astonished its readers. It retailed the assertion of no less a man than Heberden, that in England few people attained their fortieth year without having been visited by gall-stones. If it is true, the English people must be congratulated upon such an enormous improvement in their sanitary condition as is the unavoidable conclusion from a comparison of the time of Heberden with our own.

Winter Season alleged to favour the production of Gall-stone Disease.

An experience made upon cattle, that gall-stones are much more common in winter than in summer, has been transferred to man, apparently without much reason. Man is much less limited in the selection of his food than cattle, and, in the worst circumstances, not subject to the deleterious influences which cattle, particularly amongst the poorer peasantry in colder climates, have to suffer.

The circumstance alluded to in cattle is of sufficient importance to claim a special notice. The fact seems well established, as also the experience, that in spring, after green pasture, cattle part with their gall-stones. While valuable as pigments, these concretions were searched for, and not rarely found in the fæces.

Nature of Food considered as a possible cause.

All kinds of particular aliments have, at one time or another, been accused of causing these concretions, but have in turns been again completely exonerated. We know only this :—1, that flesh food predisposes least to gall-stones; 2, that vegetable food predisposes more to this disease than flesh food; 3, that mixed food affords the greatest predisposition to the disease.

Toleration, without Symptoms, of Calculi in the Gall-bladder.

We possess a great number of observations which, at first sight, tend to prove that the gall-bladder may tolerate the presence of calculi without any attempt on its part either to expel or even to react upon the intruders. Almost to every physician who is in the habit of examining the bodies of persons who have died under his care cases have occurred in which calculi found in the gall-bladder had not given rise to any symptoms during life referable to the seat of the concretions; the biliary passages were pervious, the interior of the gall-bladder had apparently its normal appearance, the bile had its usual colour in most instances, and although in some it appeared mixed with particles of colouring matter, interspersed with glistening crystals of cholesterine, and in others was of a more watery consistence, and in a third variety contained a large amount of mucus or loose epithelium of the gall-bladder and biliary passages, yet in the majority of instances it appeared, and probably was, of normal composition.

It must be borne in mind that when authors spoke of gall-stones which did not give rise to any symptoms they meant "symptoms denoting irritation in the biliary passages, or symptoms of painful contraction of the gall-bladder and biliary ducts, such as are the precursors and necessary accompaniments of the expulsion of these concretions." That part of the symptoms of gall-stone disease which, on account of its priority, was the most important, namely, the cacochymic aberration of the digestive process, not being understood, all symptoms occurring in that sphere remained unintelligible, and being localized in hidden regions of the body, formed no attractive subject for inquiry.

Passage of Calculi without Symptoms.

It was already known to J. P. Frank ('Epitome,' tom. ix, sect. vi, fasc. ii) that small biliary concretions do occasionally pass from persons not subject to any particular disorder, without creating any symptoms.

Symptoms of Calculi in the small and large Branches of the Hepatic Duct and the Duct itself.

Most writers on this subject—among them Wolff, supporting Budd—maintain that gall-stones produce symptoms only when lodged in the common duct. But this opinion has of late become very doubtful, as it has been found that calculi in the hepatic duct or ducts produce symptoms of a peculiar kind, differing from the symptoms of gall-stones in the gall-bladder and common duct by the absence of pain, and having the greatest resemblance to chronic intermittent fever. In one case, treated by Frerichs for a long time by means of quinine and other febrifuge remedies, the rigors and other allied symptoms simulating fever, were caused solely by calculi in the hepatic duct; their presence had not been suspected during the life of the patient.

As these calculi are rarely moved from the place in which they are formed, and as their formation is so gradual as to effect a corresponding expansion of the canal, they rarely produce symptoms of the passage of calculi, and do not easily give rise to jaundice. When a single calculus is lodged in the hepatic duct itself, it is most apt to cause partial or entire obstruction of the bile, intermittent pains of a not very severe description, and bilious vomitings. In a few cases the hepatic canal has been known to rupture, and the calculus and bile to be discharged in the abdominal cavity, where they produced an acute and fatal peritonitis.

The case of the physician, related by Fauconneau-Dufresne (p. 570), who passed concretions "which burned with a flame when held to the flame of a candle," appears to me not to admit of the assumption made by the reporter, that these calculi came from the hepatic duct.

A case of rupture of the hepatic duct, perhaps connected with, but not immediately caused by, gall-stones, has been related by Wolff ('Raccoglitor,' March 8th, 1850; and 'Gaz. Méd. de Paris,' 1850, p. 235). A lady, æt. 60, had for several years experienced recurrent attacks of pain in the region of the liver. On the 1st of July, 1827, she had another feeble attack, which, however, increased in severity, and caused her to vomit her dinner. She next had a violent spasm in the stomach, which compelled her to utter loud cries. On the following day the pains were more violent, the abdomen was distended and painful, the extremities were cold; cold sweats, vomiting, and suppression of the pulse supervened, and notwithstanding the use of leeches, injections, opium, and blisters, the patient died twenty-four hours after the accession of the violent spasm. At the post-mortem examination the parts round the liver were carefully dissected, and the hepatic duct was found ruptured across; the two ruptured ends floated in a mass of half-coagulated blood mixed with bile. The gall-bladder contained a large quantity of bile and two calculi of the size of peas; a smaller concretion was lying in the cystic duct, but did not close it entirely, and admitted of the passage of bile.

The account of this case is unsatisfactory in this respect, that it does not appear by what agency the rupture of the hepatic duct was produced; we may, however, conjecture that it was by ulceration, set up independently of gall-stones, or engendered by the irritation of a gall-stone passing the hepatic duct on its journey towards the gall-bladder or common duct; the ulceration once established, the passage of gall-stones into the common duct, and the consequent obstruction of the flow of bile, can easily be understood to have effected the rupture and consequent effusion of blood and bile.

Symptoms of Calculi in the Gall-bladder.

Uneasiness and pain.—When the calculi are present in large numbers, and distend the gall-bladder, they produce a sense of uneasiness in the right hypochondriac region, to which a feeling of the existence of something that drags or bears down, or distends, is not rarely added. Fabricius Hildanus relates a case in which a person affected with gall-stone in the gall-bladder experienced an uneasy movement in a place on a level with the right false ribs, as if from the shifting of foreign bodies, when in bed he turned from the right side to the left.

This uneasiness is sometimes increased to pain, which varies in intensity, and shifts or remains fixed. It may be dull, or sharp and shooting, may remain confined to the right hypochondriac region or extend over the rest of the abdomen, and send emissaries towards the chest and right shoulder.

These pains may be the effect of simple irritation of the gall-bladder and of spasmodic contraction. They may indicate the attempt of the gall-bladder to push the calculus into the cystic duct. They frequently lead to no particular result, but are in some cases the regular forerunners of an attack of liver-colic, ending in the exclusion of calculi. These attacks of pain do not often come under medical treatment; in some cases observed by Wolff they had preceded by months and years the first one which came under medical observation.

Digestive derangements.—Gall-stones not only take their origin in digestive derangements, but, when once formed, become the actual source of them. They produce pain and sickness after food; it is after meals that most attacks of colic due to concretions begin. The digestive process itself, whether by the agency of the changed bile or the interference with the other functions of the liver and spleen, becomes laborious. The appetite is lost, the tongue furred and unclean; many kinds of food are not well borne; some cause pain, others distension by the generation of gases in the intestinal tract. The evacuation of fæces is not rarely very irregular, and mostly retarded.

Palpation and percussion not rarely elicit some evidence of the presence of gall-stones when the bladder is distended, and the calculi are not too numerous, and of a certain size. On pressure over the region of the gall-bladder a resistance of unusual hardness can sometimes be felt; when the pressure is made suddenly, or when a tap is given to the spot, *a noise can be heard*, which J. L. Petit, who first discovered this diagnostic proceeding, compared to the noise which filberts make when they are moved about in a bag. This has been confirmed by the observations of many physicians, among them by such excellent auscultators as Skoda and his English rival, Cockle. Sometimes the stethoscope has to be applied to a spot adjacent to that upon which percussion is applied, in order to hear the diagnostic rattle. It is necessary to use all the precautions required for examinations of the abdomen, and to examine in the recumbent posture not alone, but also when the patient is bending or sitting with his knees drawn up to the abdomen.

A case in which Skoda established the diagnosis of gall-stones by percussion was by him sent to Carlsbad, and there passed the whole of his gall-stones while using the mineral waters.

Fauconneau-Dufresne relates at great length the case of a lady in which pressure upon the enlarged gall-bladder produced a noise characteristic of the concussion of biliary calculi.

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Symptoms of Calculi in the Cystic Duct.

The calculi formed in the gall-bladder are apt to become lodged in the neck of that organ, and thence to be driven into the cystic duct. The power by which they are thus propelled may be surmised to be mechanical pressure, aided by horizontal position or contraction of the gall-bladder from irritation or other causes.

A calculus may pass from the gall-bladder into the cystic duct and remain there, while the colics accompanying its first onset cease after a time. The cessation of colic in such a case is sometimes, but not necessarily, due to the return of the gall-stone into the gall-bladder.

Bouisson (p. 58) has observed the case of a man who, shortly before his death, suffered of intense gall-stone colic. On a post-mortem examination the cystic duct was found partially inflamed, and obliterated at its aperture into the common duct. In the gall-bladder were a number of calculi, some of them lodged in the neck; others had proceeded some way up the cystic duct.

Symptoms of the passage of Calculi through the Cystic and Common Ducts.

The common manifestations of the passage of one or more gall-stones through the common duct are a very characteristic group of symptoms, which are commonly designated as *hepatic colic* or *gall-stone colic.* To the name colic there is the objection that it really means a pain in the large intestine, and cannot properly be applied to pain in other abdominal organs. This misapplication of the word, however, seems a kind of retributive justice, for cases formerly believed to be pure spasm of the colon have now become rare since pain and spasm from gall-stones are better diagnosed.

The usual time for gall-stone colic to appear is two or three hours after eating, the period at which the greater part of the food is leaving the stomach and the cystic bile is evacuated through the cystic duct. (Wolff, Virchow's 'Archiv,' 1861; and Henoch, 'Klinik der Unterleibskrankheiten,' 2, 1856.) Commotions of the mind sometimes exert an evident influence upon the production of the spasms. The patients generally accuse various kinds of food, which, in reality, cannot be impugned, because at other times they are partaken of with impunity.

Precursory symptoms.—In cases where the pain and spasm do not appear suddenly they are preceded by precursory symptoms, such as pain in the right hypochondriac region, extending to other parts; constipation; icteric colour of the urine, and in a few cases slightly icteric colour of the face. In some chronic cases the urine becomes red a day or two before the attack begins, and does not yield the reaction for biliary colouring matter with red nitric acid.

The experience of Wolff is peculiarly valuable, as his cases were all verified to be colic from biliary calculi by the isolation of the calculi from the fæces. According to him, pain is a constant and important symptom, mostly of moderate degree, sometimes compared by the patient to the most violent pains, *e. g.* labour pains. Great importance has been attached to the seat of the pain, and Flemming ('Zur genaueren Diagnose grösserer Gallensteine,' 1832) has described as pathognomonic a pain which was to start from the region of the gall-bladder and to follow the course of the gall-ducts. Bamberger has observed that this constancy in the direction of the pain occurs frequently in handbooks, but rarely in practice.

In the majority of cases the right hypochondrium, frequently also the epigastrium, is painful. In all the cases observed by myself the epigastric region was the seat of the greatest sensibility to touch, and a spot a little to the right of it was described as the seat of the severest spontaneous pain. The pains extend towards the back, particularly towards the lower angle of the shoulder-blade, a symptom which Budd describes as characteristic of irritation of the biliary passages. Though the pain may radiate in all directions, it remains most commonly within the right half of the body, and extends towards the abdomen, the shoulder, or the right arm. In a case observed by Wolff, the father, the pain was in the intercostal spaces on the right side, and was considered as simple intercostal neuralgia. In cases observed by Wolff, the son, external pressure did not mitigate the pain, but caused a distinct sensation of pain. In some of my own cases pressure on the epigastrium was immediately followed by sickness, or violent vomiting.

The following summary of Wolff's experience regarding other symptoms connected with the passing of gall-stones is given for the reason already stated. It accords with our general clinical knowledge in a remarkable manner, but some diagnostic points come out more prominently, and impress themselves better on the memory and the imagination than would a mere abstract of general clinical experience.

During violent paroxysms the patients assumed various positions—crouching, bending their bodies in many ways. In the severest cases there was great restlessness, delirium, and even syncope. In the majority of cases the pain was less violent, and resembled more a dull sensation of pressure or uneasiness. During the paroxysm the pain was not of a stationary degree, but increased and decreased in turns. During violent colics the abdominal muscles were spasmodically contracted, the abdomen consequently hard, sometimes a little distended, but generally soft and yielding. Strong pressure was sometimes more painful in the epigastric region than in the hepatic region. The observation of Beau, who found the liver distended during the attack, Wolff could in some cases confirm.

In the intervals between the attacks of colic the right hypochondriac region and the epigastric region remained frequently very sensitive to pressure; the patients sometimes complained of a dull, pressing sensation in the region of the liver, but otherwise were free from pain. In the simple cases without jaundice the liver showed no changes in its dimensions, but when jaundice was present, and lasted for some time, a considerable increase in the size of the liver could frequently be observed.

In the majority of cases the stomach was deeply implicated. Eructations, sickness, and vomiting, were the usual accompaniments of the colic. Mostly the food from the last meal was vomited; if a longer time had elapsed since the last meal, a mucous fluid was generally ejected, which rarely contained any admixtnre of bile. Only the violent attacks were accompanied by vomiting; and if these attacks followed each other in rapid succession, the nutrition of the body suffered materially. If, on the contrary, the attacks followed each other at longer intervals, the general condition of the patients suffered very little, appetite and digestion remained normal, the complexion remained healthy, and nothing reminded the patient or physician of past storms. Any complications, of course, changed the aspect of the case materially.

The *action of the intestines* was very irregular. Sometimes there was constipation, at other times or in other cases there was diarrhœa, frequently diarrhœa alternated with constipation. In the absence of jaundice the stools had a perfectly healthy colour.

One of the most important symptoms of the colic is the *condition of the pulse*. Already Coe expressed his surprise that in gall-stone colic he had found so quiet a pulse and so little fever. Heberden ('Lond. Med. Transact.', 1772, vol. ii) relates the history of a man who suffered of such violent colic, that nine grains of opium, given in twenty-four hours, could hardly mitigate the pain, and all the time his pulse beat as quietly as if he was lying in a deep sleep. He consequently puts great stress upon the slow pulse as a diagnostic point.

Pemberton ('A Practical Treatise on various Diseases of the Abdominal Viscera,' 1806) states, as the principal difference between inflammatory pain and pain from gall-stone colic, that in the latter external pressure had the effect of mitigating the pain, which was not so in the former; colic, moreover, made the patient inclined to perspiration, and his pulse did not rise above 100 beats per minute.

Notwithstanding these distinct statements of older English authors, modern writers on gall-stones have paid little attention to the pulse during the attack of colic, and have made varying statements regarding its condition. Fauconneau-Dufresne found it in most cases small and rapid, an assertion which is repeated by Henoch. According to Bamberger, the pulse ordinarily shows no acceleration; sometimes it is even normal, or below the normal numbers; in very violent attacks it is small, rapid, and even insensible. Budd found the pulse slow and small. Wolff explains the contradiction of these observers by the assumption that they had not separated pure and simple cases of gall-stone colic from those in which complications existed, such as ulceration of the gall-bladder or gall-duct, inflammation of these organs, and so on, in which, therefore, conditions existed which may cause a small and frequent pulse. In the pure cases of gall-stone colic—and such were almost all the forty-five cases observed by Wolff—*the pulse was certainly not accelerated;* on the contrary, this physician found, in accordance with the observations of the English authors, the pulse constantly retarded. This retardation of the pulse appeared in every attack, and according to its severity amounted to a lessening of the beats of the pulse by from five to ten beats per minute. In these observations notice was taken of the fluctuations of the pulse at various times of the day; and in order to know the normal frequency of the pulse in the various patients, it was carefully examined during the time they were free from colic, and the result noted down. The precaution was taken to make the observations always in the same posture. If the physician could not himself make the necessary observations upon the patient, an intelligent person among his relations was intrusted with this commission. The symptom of diminished frequency was so constantly found during frequent observations, that in doubtful cases (*i. e.* in absence of jaundice) it was mainly relied upon for the diagnosis. Wolff the younger observed it for months almost daily in a patient, who had daily attacks. The pulse was not small, but large and regular.

This retardation of the pulse was found in cases with and without jaundice, and did, therefore, not exclusively depend upon this disorder, though it is a frequent consequence of it.

Türck ('Sitz. Ber. d. K. Akad. zu Wien. Math. Phys. Cl.', xvii, 2) has observed a periodical retardation of the pulse during attacks of neuralgia of the fifth nerve. Valleix ('Traité des Neuralgies,' 1841) has never found a diminution of the frequency of the pulse in cases of neuralgia.

The respiration was impeded during the paroxysms, the short and rapidly succeeding inspirations indicating a slight degree of dyspnœa, occasioned, probably, by impeded action of the diaphragm. In the common attacks respiration was perfectly free. The retardation of the pulse cannot, therefore, be explained by voluntary suppression of respiratory action, an explanation to which the well-known experiment of Weber might in some cases lead.

Hiccough was rare, and occurred only in very violent attacks.

Frequently, though not always, the attacks were accompanied by shivering, which in the more severe cases amounted to violent shaking rigors, resembling exactly the cold stage of intermittent fever. The sensation of coldness was so great in a lady, that hot bottles and blankets, in the hottest days of July, were not sufficient to get the patient warm. The commencement of the rigors was always, as has already been remarked by Pemberton, subsequent to the beginning of the pain, and ceased before the pain ceased.

The cause of the rigors and shivering is probably the expansion of the ducts and irritation of their walls, as Budd suspects. He compares them to the rigors which, in cases of stricture of the urethra, are caused by the introduction of a catheter, or are sometimes witnessed when the colon is distended by fæcal matter. A certain sensation of coldness is seldom absent, even in the slightest attacks.

Towards the end of the colic there is mostly a slight perspiration, which eases the patient. In violent attacks the patients are bathed in perspiration.

In some patients, who were subject to hysteria, there were yet globus, spasms of the extremities, and violent headache. Bamberger has described such cases. The cases described by Duparcque ('Rev. Méd.', 1844) of clonic spasms during gall-stone colic deserve to be compared.

That jaundice is not a necessary symptom of gall-stones was first shown by Morgagni, in the often quoted thirty-seventh letter of his celebrated work on morbid anatomy.

As the experiments of Saunders ('On the Structure of the Liver,' 1785) show that the common duct must have been occluded for some days before jaundice becomes strongly marked, it follows that even large gall-stones, causing complete obstruction of the common duct, may pass into the intestine without causing jaundice, provided they pass quick enough. Cases in which large concretions were passed from the gall-bladder and expelled from the bowels without ever having caused a trace of jaundice, are not rare. The two most notable cases are those described by Meier ('De magno ves. fell. calc.', 1768) and Delius ('De cholelithis observ.', 1782). In the clinical record appended to this chapter will be found several cases, particularly one recorded by Dr. Omond and another by Mr. Childs, in which large biliary concretions made their way from the gall-bladder to the outer world, without having caused jaundice at any period of a protracted illness.

But although it is well proved and generally admitted that jaundice is not a necessary consequence of the passage of gall-stones through the common duct, the opinion, nevertheless, is very prevalent that in by far the greater proportion of cases of gall-stone disease jaundice is at one time or another observed. In the cases observed by Wolff the reverse of this assumption took place. In twenty-five cases there was, during the whole duration of symptoms, no jaundice, and it was present only in twenty. The number of cases in which no jaundice appears is probably still larger in comparison to those in which it appears, as cases of the former kind easily escape diagnosis, while those accompanied by jaundice are never lost sight of. In cases where there is no yellow skin all indications as to the time at which the calculi may pass in the fæces are absent, and particular care must be taken to examine the fæces in order to discover calculi. The only sure mode of searching for calculi is the proceeding first pointed out by Olaus Borrichius (see p. 35), which consists in throwing the fæces on a sieve, and washing them carefully with large quantities of water. Prout ('On Stomach and Urinary Diseases,' 3rd edit., 1840, p. 264) advised to mix the excrement with water, when the stones would float on the top of it. Watson has, however, long ago shown that no calculi are ever obtained by this proceeding, and that it was based upon an erroneous notion of the specific gravity of gall-stones, observed upon old and dry specimens.

In the cases without jaundice observed by Wolff the symptoms, though sometimes very violent, as a rule were of moderate severity. From the beginning of the first attack of colic until the calculi were expelled, two to eight months, in the longest case thirteen months, elapsed without any trace of jaundice making its appearance during that time. In the majority of cases the calculi were of moderate or insignificant size; some, however, were the size of a filbert. Of two which were distinguished by their size, one weighed thirty-two grains, had the shape of a parallelopipedon, with a quadratic basis of sixteen millimètres' length of each side, and of the height of one centimètre. All edges and corners were rounded off. The second calculus weighed twenty grains, had nearly the shape of a ball, a diameter of thirteen millimètres, and showed four planes. In both cases two or three smaller calculi were yet passed. These large calculi prove again that the mere size of the stone is no condition of jaundice. On the other hand, it was found that the small calculi of the size of a pea frequently cause jaundice. The shape has also been brought in connection with jaundice, and Barth ('Gaz. hebd.,' 1854, 1, 23) maintained that angular calculi caused no jaundice, because the bile could pass by the side of the stone, but that round calculi necessitated jaundice.

Wolff admits that this may be true for large calculi, but not for small ones. Both round and angular calculi, large and small, occurred with and without jaundice. Most small calculi which caused jaundice belonged to the polyhedric variety. It must be borne in mind that in different individuals the length and width of the canal varies considerably; so does their irritability. In one case the bile collects behind the obstructing calculus, distends the canal, and pushes the calculus into the duodenum. In other cases the irritation of the concretion causes a spasmodic contraction of the muscular coat, which in the common duct is of considerable thickness, prevents the expansion by bile, or opposes great resistance to it, and causes a long retention of bile.

In cases in which jaundice appeared two periods could be distinguished. The majority of the attacks of colic, some of them very violent, were not accompanied by jaundice, and were evidently caused by the irritation of the spiral valve in the cystic duct, which impeded the passage of the calculus. Upon this relation much stress has been laid by Fauconneau-Dufresne. After attacks without jaundice had occurred during several months, at last, *at the end of an attack of colic*, jaundice appeared, and on the same day, or a few days later, the calculi were passed. The course of events made the impression as if the calculi had been impacted in the narrow mouth of the common duct. In rare cases the jaundice lasted for some time, and reached a certain degree of intensity, while in most cases it only exhibited itself as a yellow tinge of the conjunctivæ. After expulsion of the calculi the jaundice quickly disappeared.

Intervals between the attacks of colic occur with calculi in the common duct, where the retention of the calculi in these passages is proved by the continuance and increase of jaundice.

In Wolff's cases the *duration of colic* was several hours; in rare cases they lasted one or two days; they returned sometimes daily with great regularity; in other cases they left free intervals of some days, weeks, or months.

The expulsion of the calculi, if there were several, occurred in rapid succession. In rare cases it took a long time for their expulsion, which could not be looked upon as completed before the expiration of some months from the beginning of the colic. All forty-five cases terminated in the expulsion of the calculi by the intestinal canal. All calculi passed through the normal biliary ducts, and in no single case was there any ground, either in the course of the symptoms or in the unusual size of the calculi, for assuming that there was an abnormal communication between the gall-bladder and the intestinal canal. In no case did the calculi produce any symptoms by their sojourn in the intestinal canal.

Duration.—The case which, from the first accurately observed attack of colic to the final expulsion of the calculi, lasted longest, stretched over eighteen months. In most cases the duration of the expulsive efforts was only from two to twelve months.

The whole of the expelled concretions belonged to the cholesteric class, and possessed a pigment nucleus of varying size. Some larger ones consisted of alternating layers of cholesterine and pigment. Most of them were small, of the size of peas and upwards, and then were passed in large numbers. Those of the size of a filbert were rarer, and passed in numbers of between two and five.

Symptoms of Gall-stones in the Intestinal Canal.

When the irritation produced by gall-stones is severe, and vomiting continuous, it passes not rarely into antiperistaltic action of the duodenum. Gall-stones which pass from the common duct into the cavity of the intestine are, under these circumstances, moved upwards into the stomach, and thence ejected by continued vomiting. Of this nature was the case observed by Gentilis (see p. 16). Fred. Hoffmann ('Med. rat. syst.', vi, obs. 2, p. 44) mentions the case of a patient who, while suffering severely from hepatic colic, imprudently took a drastic purgative. He became violently sick, and vomited twenty angular calculi, which were of a greenish-yellow colour, and weighed a drachm and a half. Their expulsion had been preceded by jaundice, and was immediately followed by the disappearance of that symptom. Notwithstanding this successful termination of the expulsive efforts, the patient died. Huxham, in a letter to Coe (see his 'Treatise,' &c., p. 73, note) mentioned that he observed two cases in which gall-stones were discharged by vomiting.

The Count de Guemès, at the age of forty-five, while in Spain, had repeatedly suffered of hepatic colic. Subsequently, when living very imprudently at Paris, he had become the victim of numerous long and painful attacks. Portal, having been called to the patient, found him suffering severe pain, screaming aloud, and throwing his arms about. The abdomen was painful, particularly at the epigastrium and in the region of the gall-bladder, where a tumour could be felt, which, no doubt, was the gall-bladder itself filled with bile. After a venesection and the administration of some soothing remedies, the pain became lessened and vomiting set in, by which a great amount of biliary matter, mixed with yellowish granular concretions, was discharged. The gall-bladder at first retained its size, but after, by means of continued vomiting, a quantity of blackish-green bile had been discharged, the tumour disappeared, and the patient, who had been slightly jaundiced, regained his usual state of health.

Fauconneau-Dufresne has published the following case, originally communicated to him by Dr. Camille Piron. A woman, aged thirty-six, vomited, after great efforts, a calculus of the size of a large nut. She had often vomited before; her digestion had been deranged, and she had become emaciated, which had made it probable that she was afflicted with scirrhus of the pylorus. She also had been jaundiced several times, and vomited a calculus some years before the one which caused her to apply to Dr. Piron. A short time after this occasion she vomited a third calculus.

Bricheteau ('Clinique de l'hôpital Necker') observed a lady, aged forty-nine, who had for some time been suffering of hepatic colic; all of a sudden she vomited a round body, of the size of a filbert, which could easily be broken. After this she had very strong colic pains, and passed a large quantity of muco-bilious matter, with much fæcal matter in her stools.

Ch. Petit ('Mémoire sur les eaux minérales alcalines de Vichy,' &c., Paris, 1843) relates the case of a Portuguese gentleman, aged sixty, who, in consequence of misfortune and grief, had become affected with hepatic colic and icterus. Although the gall-bladder was distended and painful, the patient began the use of the Vichy water, and bore it at first tolerably well. But after the lapse of three weeks he vomited a large quantity of greenish fluid. After two basinfuls of this fluid had already been thrown away, the patient was for the first time able, in a moment of calm, to order that the vomited matters should be examined, as he had felt something hard which had scratched his throat. When the matters vomited subsequently to this order were examined, six facetted biliary calculi were found in them, of which the largest one was of the size of a filbert. These attacks of sickness, accompanied with terrible spasms, continued during eleven consecutive days, at the conclusion of which fifty-eight basins more or less full of vomited matters had been emptied. There was jaundice, but not of a severe nature. A fortnight after this attack the use of the mineral water was resumed.

A similar but fatal case, related by Bouisson, has already been given on p. 127.

Most biliary calculi, after their arrival in the intestinal canal, pass through it without any difficulty. But in some cases, where their large size precludes an easy and quick transit, they cause irritation of the narrower parts of the intestinal canal, and eventually are retained by a constricted portion of the gut, causing the usual symptoms of obstruction of the intestine. In most cases, though not in all, this accident is fatal.

Of calculi simply retained in the duodenum there is no example extant, but there are some cases on record in which the calculi were retained in pouches of the duodenum, produced either by relaxation (as is assumed) or by ulceration proceeding from the gall-bladder. Of the former kind, probably, was the case mentioned by Chomel ('Histoire de l'Académie royale des Sciences,' 1710, obs. anat. 3). "In the body of a decrepid woman there existed a little sac, formed by relaxation of the walls of the duodenum, and filled with calculi." To the latter class belonged the case brought before the Royal Medical and Chirurgical Society by Mr. Edward Wilson Duffin, on May 9th, 1848, and related in the 'Lancet' for May 27th of the same year, p. 582. The patient, a man sixty-five years of age, had on several occasions during the last three years consulted the author for symptoms that were presumed to proceed from deep-seated, subacute inflammation of the liver. He was also subject to dyspepsia. On the night of the 25th of January last he was seized with vomiting and hiccough, which continued, with only trifling intermissions, for three days. On the third day he vomited about three pints of a fluid like coffee-grounds. Uneasiness in the abdomen, a little to the left of the umbilicus, had annoyed him occasionally for some time, and there was now tenderness in the same situation. There was no jaundice, but he gradually became much emaciated, and at length, without new symptoms, died on the 9th of March. On examination after death two folds of intestine to the left of the umbilicus were found adherent to each other by recently effused lymph, and in an angular, pouch-like dilatation of this portion of intestine (the jejunum) a large, wedge-shaped concretion was found. The gall-bladder in its entire length on its under surface was found to have been destroyed by ulceration, the edges of the remaining portion being continuous with the edges of a large perforating ulcer in the anterior walls of the duodenum. The duodenum presented two pouches, of one of which the anterior part of the gall-bladder formed the apex. Lodged in these pouches were three large biliary concretions. The length of the four concretions, all of which had bevelled surfaces, was, when they were fitted together, six and a half inches. Their weight was two ounces, five drachms, nineteen grains. The author referred to two similar cases, one related by Cruveilhier, the other by Mr. Blagden, of Petworth, in the 'Chirurgical Transactions,' vol. iv. In neither of these cases was the mass of concretions so large as in the present instance.

Cases of retention of calculi in the small intestines are of more frequent occurrence. The following cases were fatal:—Monod, 'Bulletin de la Société anatomique' du 6 Mars, 1838; Broussais, 'Annales de la doctrine physiologique, Août,' 1827, No. 8; Puyroyer, 'Extrait du rapport de M. Maisonneuve sur l'observation 3me.' Of the symptoms of these cases Fauconneau-Dufresne gives the following summary. Vomiting appeared soon after the hepatic colic, and did not cease until death. The vomited matters at first contained food, afterwards greenish or brownish-yellow bile, and at last fæcal matters. The abdomen was painful, distended at the epigastrium and all round its upper part, flat and sunk in at its lower part. There was always constipation, although the fæces could be felt in the colon. In a case to be related below it was believed that the obstructing body itself could be felt. The countenance was collapsed, the pulse small and frequent. The patients always sank rapidly, and death took place on the sixth or eighth, in the last case on the twenty-sixth day after the setting in of the symptoms. In two cases the obstruction existed in the jejunum, in one in the ileum. The obstruction was complete, and did not permit any fluid to pass. The calculi causing the obstruction are described as being of the size of a pigeon's egg, or an inch and a quarter in diameter. In the observation of Puyroyer the obstructing body was a cylinder of conglomerated calculi; on the whole the calculi were not of the largest description, as much larger ones, up to the size of a turkey's egg, have been known to pass through the intestines, and be voided by the anus. Above the obstruction the intestines were always much dilated. In the observation of Monod the dilatation extended as high as the middle of the œsophagus. Below the obstruction the intestine was generally found contracted. In the immediate neighbourhood of the impacted concretion there was always much inflammation and congestion.

To this summary of cases the particulars of the following two fatal instances deserve now to be added. The first was brought before the Pathological Society on January 4th, 1859, by Dr. van der Byl, and reported in the 'Medical Times and Gazette' for January 22nd, 1859, p. 99, as follows:—Two large gall-stones, being short truncated cylinders of nearly an inch in diameter, were shown. Death had been caused by the impaction of one of these in the small intestine. The patient had died with all the symptoms of intestinal obstruction, the cause of which it had been impossible to diagnose. At the autopsy the gut was found distended above the calculus, and contracted below. The stone fitted just as a cork might do, and had evidently been in course of passage downwards. Its fellow still occupied the gall-bladder.

In the next case the calculus passed from the gall-bladder into the small intestines by a fistulous communication. It was reported by Renaud in the 'Archives Générales,' and a translation of it was published in the 'London Med. and Surg. Journ.', 1834, p. 312. A female inmate of the Salpêtrière, seventy-five years of age, had enjoyed perfect health, although she had been subject to habitual costiveness. On the 11th of January, 1834, after a meal, she was seized with vomiting, which persisted during the night and for several subsequent days.

On the 14th of January, the date of her admission into the infirmary, her symptoms were as follows: frequent vomiting of alimentary matters, then of bilious fluid, no headache, very little thirst, acute pains of the epigastrium and right side, slight abdominal tension, constipation. On examination of the region of the colon, some hard stercoral matters were felt. A cataplasm on the epigastrium and enemata were ordered to be applied.

On the 15th she had copious vomiting of green matter, free from odour; her countenance was shrunk, her eyes sunk, the tongue was dry, red at the point; the abdomen was less sensible to pressure, compact rather than tense, her skin was hot, her pulse thready. The cataplasms were continued, and an oily emulsion was given.

The 16th found the vomiting still bilious, without smell; she had alvine evacuations. The pain in the abdomen became acute, the pulse could scarcely be felt, the extremities became cold. Something like a round body, which might obstruct the stercoral matters, was felt through the abdominal parietes on the right side. On the 17th she died.

Post-mortem examination.—The dilated stomach descended as far as the hypogastrium: the duodenum was in its natural position, being retained there by adhesions with the gall-bladder and liver. The intestinal tunics were sound, but the upper portion of the small intestines was considerably dilated through several feet of extent; the lower portion was diminished in diameter. In the upper part of the small intestine there was an oblong, very hard tumour, as large as a pigeon's egg, which must have prevented the progress of the fæcal matters. The tumour was caused by the presence of a biliary calculus. There were solid adhesions between the gall-bladder and the duodenum, and an extensive loss of substance bounded by these adhesions allowed a communication between the two cavities. This perforation did not appear to be of long standing. The large intestine contained very hard fæces.

Happily this accident of the impaction of a calculus in the small intestines is not always fatal. The following cases will illustrate the condition under which we may hope a favorable issue of the disorder, and indicate some of the means which we ought to employ for its removal.

The first case was observed by Mayo, and referred to by the president of the Pathological Society during its meeting on January 4th, 1859 (see also 'Gaz. Méd. de Paris,' 30 Décembre, 1843).

A patient had, for some time, been suffering all the symptoms of intestinal obstruction, but they had suddenly been removed after a careful examination of the abdomen by pressure. It appeared that the surgeon's manipulation had been the means of dislodging the impacted stone, which was voided by the rectum very shortly after the visit.

The second case of impacted gall-stone in which recovery was effected by medical aid was related by Dr. Omond in the 'Edinb. Med. and Surg. Journ.', and reprinted in the 'Lond. Med. and Surg. Journ.', 1836, 8, 351.

A married woman, forty years of age, complained of extreme tenderness of the abdomen, much increased by moving, with the general symptoms of fever, the pulse full and strong, and the bowels confined. She stated that she had frequent attacks of inflammation of the bowels, the last being a few months ago; that constipation was always a prominent symptom; and that the remedies used were bloodletting and strong purgatives. She is of gross habit of body. After bleeding, a cathartic prescription was given, containing calomel and colocynth.

On the second day she was bled; it partially relieved the pain in the abdomen, which returned only at intervals. Various medicines were tried, but all were speedily vomited. Several injections were also administered, but without effect, not being retained for any length of time.

On the third day stercoraceous matter was ejected by vomiting, and the symptoms continued very urgent.

During the three following weeks every medicine tried completely failed to afford any relief, the stercoraceous matter being still ejected two or three times a day. Strongly purgative enemata failed to relieve the bowels. Although the patient took nourishment daily, she was nevertheless made weaker. The enema syringe was now employed by the attending surgeons, instead of by a nurse as formerly, and very large quantities of fluid used, to the extent of several basinfuls. After the third attempt, some fæculent matter appeared.

The pump was now used daily during an entire week, the fifth of the illness. The vomiting ceased entirely. A strong cathartic was now given, containing seven grains of calomel, this on the next day was followed by copious discharges of fæces, and the evacuation of a calculus measuring three inches in circumference. The calculus was crystalline, and consisted of cholesterine.

During the following month the patient passed several smaller calculi. She improved gradually, and was at last so far recovered as to be able to walk about.

A third case is described by Frerichs (loc. cit., p. 546).

Count G—, a healthy man, fifty years of age, resorted to Karlsbad in the spring of 1856, on account of slight jaundice, accompanied by moderate enlargement of the liver and habitual constipation. Temporary improvement followed; but already in July the colour of the skin was again pale-yellow; the patient complained of dull pains in the right hypochondriac region; the appetite ceased, and the bowels became more and more confined.

A state of constipation, lasting for several days, was gradually developed, which the medical attendant of the patient endeavoured in vain to remove by means of rhubarb, Saidschütz water, compound infusion of senna, and other means. At last calomel was tried, but remained without effect; vomiting set in, the abdomen became distended, and more and more tympanitic, but was free from pain.

The vomited matters consisted at first of a greenish-yellow mucous fluid; subsequently they assumed a dirty-yellow colour, and became fetid, and at last they emitted an unmistakeable stercoraceous odour; at the same time there was dyspnœa, with great anxiety, and cool extremities.

Frerichs advised the discontinuance of the purgative, and the substitution of small doses of morphia, together with ice. The bowels were acted upon by the often repeated injection of large quantities of tepid water. The vomiting upon this ceased, and the patient became tranquil, but the bowels, nevertheless, remained obstinately confined. Thereupon an infusion of three ounces of water upon five grains of belladonna leaves was injected into the rectum. As it produced no effect, it was repeated in the evening. It was followed by restless sleep, interrupted by delirium, by enlargement of the pupils, and other symptoms characteristic of the action of belladonna. On the following day the injections of tepid water were resumed. About noon the fluid which came away began to be coloured, and about two o'clock a bulky fæculent stool was passed, causing severe pain at the sphincter. The stool contained a globular, brown calculus, rather larger than a walnut, composed of cholesterine, presenting a radiated structure, and surrounded by a layer of dried fæces several lines in thickness. The effects of the belladonna lasted for several days, after which complete recovery took place.

Gall-stones, like other foreign bodies passing through the intestinal canal, are sometimes driven into the vermiform appendix. One fatal case of this kind has been noted down by Wegeler ('Journ. de Méd. Chir. et Pharm.', par Corvisart, Leroux et Boyer, tom. 28). It was that of a young man of eighteen, who had for some time suffered of colic. These attacks became more severe, and were at last complicated with a painful swelling in the right inguinal region; next supervened vomiting of matters, which were at first bilious, afterwards stercoral, and under these symptoms death ensued. The vermiform appendix contained several biliary calculi, and was very much inflamed; the cæcum was gangrenous.

Another case, in which a biliary calculus entered the vermiform appendix, and was ultimately discharged from the right groin, has been related by Dr. Adolphe Sirey (see 'Med. Times and Gazette,' October 8th, 1859, p. 372). The calculus had caused inflammation and suppuration in the appendix vermiformis and the parts around it, and, through an ulcerated opening, had found its way outwards through the abdominal walls. The case related by Civadierus, mentioned under the chapter on biliary fistulæ, admits, perhaps, of a similar interpretation.

When gall-stones cause any obstruction in the large intestine, it is mostly at the inner or outer sphincter of the rectum; there they become lodged, and prevent the passage of the fæces either partially or entirely. A careful examination of the rectum by means of the finger, and of the colon by means of an elastic tube, should therefore always be made.

The expulsion of the calculi through the anus takes place under a variety of circumstances. There are cases on record where a calculus, of considerable size, was voided by itself, without any accompanying fæces or other matters, and arrived at the bottom of the pan of the commode with the sound usually produced by the falling of light, hard bodies, as in the following case. Ann Aldred, æt. 71, had violent pains in her sides during a period of three months, at the termination of which she evacuated a gall-stone per anum with considerable difficulty, unaccompanied by fæces. Immediate cessation of pain ensued, and four months later she had had no return of her complaint. The calculus was given to the College Museum by Sir William Blizard, in 1822. A. 103, catal. p. 179. In other cases the concretions are buried in the midst of ordinary fæces, as in the case of Madame Noël, reported by Portal in his work on liver diseases (Paris, 1813, p. 177); sometimes, also, the fæces formed a shell round the nucleus of the size of a hen's egg, similar to the shell round the impacted calculus in the case related by Frerichs. Frequently the stools were, what in ordinary terms is called bilious, which means coloured yellow, red, or brown, by altered colouring matter of bile. In rare cases blood was mixed with the matter accompanying the fæces. In all cases the fæces should be sifted in the manner alluded to in a former paragraph.

Calculi may cause obstruction of the intestine by their number as well as by their size. Fauconneau-Dufresne has observed complete obstruction of the small intestine by a cylinder composed of conglomerated calculi. In a case related by Bermond ('Bullet. Méd. de Bordeaux,' and 'Lancette française' du 27 Février, 1834) a temporary obstruction was caused by a large number of calculi, which were ultimately evacuated under great pain, with a large quantity of fæcal matter. The bulk of the calculi is somewhat dramatically described as equalling the size of two fists. As the calculi do not appear to have been isolated, counted, or weighed, we must suppose that the bulk of two fists was made up of the calculi including the fæcal matters with which they were excreted.

The calculi passed per anum are sometimes of surprising size. Common is the size of a walnut (Wilson, Pujol, Frerichs, and others). Imbert, who was at one time chancelier of the University of Montpellier, in his 'Dissert. de lapidibus biliariis,' states that he saw a calculus of the size of a hen's egg, which had been passed by a lady of high rank. Guilbert mentions a similar observation, which had been made and communicated to him by M. Petit, late dean of the physicians of the Hôtel Dieu. Other cases are mentioned in the old 'Journal de Médecine,' in the 'Gaz.

Méd. de Paris,' 30 Décembre, 1843 (calculus weighing 10 grammes, observed by Johnson), and in the 'Bullet. de Thérapeutique' for 1845 (calculus weighing 12½ grammes, length 4½ centimètres, thickness 2½ centimètres, observed by Cosseret, of Toulon).

Among the largest calculi passed per anum is one presented to the Museum of the Royal College of Surgeons, in 1819, by H. P. Fuller, Esq., and described and figured in the catalogue, p. 168, and plate 17, fig. 8. It is oval, measures one inch and three quarters in length, by one inch and a half in diameter, and was passed per anum by a Mrs. Smart. Its centre is composed of nearly pure crystallized cholesterine, while its exterior consists of cholesterine mixed with the colouring matter of the bile. It deserves to be noticed that the sister of this lady was also afflicted with gall-stones, and voided a large one per anum, which is also preserved in the College.

Another calculus in the Museum is A. 80, catalogue p. 176. It is egg-shaped, and measures nearly two inches in length. It consists of impure cholesterine, and has the following history in the Sloanian Museum Catalogue:—"A large stone voided by a gentlewoman (Mrs. Anne Wright) who had been many years troubled with the colic."

In this category belongs the case of Bezold related on p. 34. The case related by Petit ('Malad. Chir.', 1, 325), after Habut, would also have to be related here, were it certain that it concerned a biliary and not a purely intestinal concretion.

Sometimes calculi are voided which, from their shape, make it probable that others have gone before them or remain behind in the gall-bladder, biliary canals or intestinal cavity. Fiedler ('Medic. Jahrb. des K. K. Oesterr. Staates,' Bd. 3, Hft. 1) relates the case of a man of sixty-seven, who, after hepatic colic, evacuated with the stool a calculus of the size of half a hen's egg, and on the day following another calculus of similar size and shape; the calculi fitted each other by two planes, thus showing that they had been together in the gall-bladder. Their size precluded the supposition that they had passed by the natural dilated channels, and compelled the observer to assume that they had passed from the gall-bladder by ulceration. This opinion is shared by Cruveilhier, 'Anat. Pathol.', livr. 12me, obs. viii.

Van Swieten, in his 'Commentaries to the Aphorisms of Boerhaave,' 151, § 950, gives the case of his mother-in-law, who had been subject to attacks of jaundice; two days after a lively attack of pain in the region of the duodenum she passed a calculus of the size of the last joint of a thumb, having on its surface two grooves, which indicated that other calculi remained behind; they were, in fact, evacuated a short time afterwards, and their size was not much inferior to that of the first one.

Gall-stones leaving the Gall-bladder by ulceration and passing through the Abdominal Walls.

Soemmering, l. c., p. 20, preserved a gall-bladder, which was full of concretions; some had, during the lifetime of the person from whom the preparation came, been evacuated through an ulcerated aperture in the fundus of the bladder. Cheselden, 'The Anatomy of the Human Body,' edit. xi, Lond., 1778, p. 166, saw two calculi, of six lines diameter, pass through the walls of the abdomen. Similiar cases are related in 'Acta Roterodamensia,' tom. i, p. 509, and by Lind, 'Journ. de Méd. et Chir.', Paris, 1789.

Hofmann observed 80 biliary concretions pass through an ulcer in the abdomen. Compare Crell's 'Chem. Annalen,' Stück viii, 1789; Bloch, 'Med. Bemerkungen,' Berlin, 1774, observed calculi discharged through a fistula under the false ribs.

Tolet, 'Op. de Lithotomia,' cap. iv, p. 24, saw a biliary concretion of the size of a pigeon's egg pass through an ulcer at the navel.

Buettner, 'Fünf besondere anatomische Wahrnehmungen,' Koenigsberg, 1774, observed thirty-eight gall-stones discharged from a fistulous opening at the umbilicus.

Haller, A., 'Opusc. Pathol.', tom. iii, p. 324, Hist. 8, observed gall-stones discharged from an ulcer in the epigastrium.

Civadierus, 'Nouvelles oeconomiques et littéraires,' tom. xx. The calculi passed through an ulcer in the right groin. Compare 'Hamburgisches Magazin,' Band xxi.

According to Schurigius, 'Lithologia,' p. 268, J. Fabricius removed two biliary concretions from a living man by means of cutting.

None of the above eleven cases were mentioned by Fauconneau-Dufresne in his account of the literature on biliary fistula, although they had already, in 1795, been collected by Soemmering. To the twenty cases collected by Fauconneau, the following are the references:—J. L. Petit, 'Malad. Chir.', Paris, 1790, 1, 285; Borrichius, 'Act. reg. societ. med. Havniensis,' 1676, obs. 176; Despine, 'Recueil périod. de la Soc. de Méd. de Paris,' 37, 290; Lombart, ibid., 6, 93; Dargeat, in Petit, l. c., 315; Saurau, ibid., 323; Meersman, 'Mém. de la Soc. de Méd. d'Anvers,' and 'Gaz. Méd. de Paris' du 25 Avril, 1840. A case under the care of Fouquier, and another under the care of Cruveilhier and Rostan, reported by Fauconneau-Dufresne, in 'L'Union Médicale' du 29 Avril, 1847, and in 'Mém. de l'Acad.', &c., p. 165; Rossi's case, communicated to the Scientific Congress of Italy, held at Genoa in 1846, mentioned by Fauconneau-Dufresne, loc. cit., p. 167;

Manec, in 'Thèse de M. Guilbert;' Klemm, 'Berliner Med. Centralzeitung,' and 'Gaz. Méd.', du 2 Juillet, 1842, p. 425; Andral, 'Anat. Pathol.', 2nde partie, p. 610; Aug. Bonnet, 'Traité des Malad. du foie,' 2nde édit., Paris, 1841, p. 308, reporting a case observed by Thélésius, and one observed by himself; Eller, of the Academy of Berlin, in 'Collect. Acad.', t. 10; Marjolin, two cases, related to Fauconneau-Dufresne; two cases observed by Grandclaude and Levacher, and related *in extenso* by Fauconneau-Dufresne. Three cases are mentioned by Walter, and several others have been recorded by Oppolzer (' Zeitsch. der Gesellsch. der Aerzte in Wien,' Nov., 1860). To this number of thirty-seven cases I shall have to add abstracts of eight cases recorded in the periodicals of this country, which will swell the number of cases readily available for study and reference to forty-five. This does, however, not include many cases on record in literature, of which we possess some indirect information.

This disease mostly begins with obstruction of the biliary passages, which causes a distension of the gall-bladder by accumulated bile. The bladder and the tissues around it next become inflamed, and adherent to each other and to the peritoneum. Ulceration is then set up, either within the gall-bladder or in its neighbourhood, in consequence of the formation of abscess, which penetrates the gall-bladder on the one, and other organs, the duodenum, ileum, and the abdominal wall on the other side, and opens ultimately outwardly, or is opened by surgical means. Sometimes the abscess is formed in the liver itself, as in the case of J. Dundas, related in 'Med. Essays and Observations,' 2, 345, obs. 29, and then is mostly fatal before it has had time to open on the skin. The enlarged gall-bladder in some cases becomes very large, reaching, as in the case of Grandclaude, the size of a child's head. In other cases it is not much enlarged, as the ductus cysticus becomes closed at an early stage of the disorder; this was the case in the observation of Cockle. In some cases the growth of the tumour is rapid, in others the disease proceeds slowly, and is tedious and wearing. At last fluctuation appears underneath the skin, the abscess points, and under the usual symptoms the skin is pierced by the abscess, or the calculus from within, or by the knife or caustic from without. Thus in the case of Manec the abscess opened by simple ulceration; in that of Lespine an incision was made and the knife reached the calculus itself. The abscess once opened mostly discharged pus, bile, and calculi, and continued to discharge pus and bile for a time at least, and calculi at intervals; in cases where the cystic duct was closed the first portion of pus only had a biliary colour, all subsequent discharges were free from biliary colouring matter. In rare cases the fistulous opening discharged only a mucous fluid.

The number and size of calculi passed through fistulous openings was subject to great variations. In the case of Dassit forty calculi were gradually evacuated, in the case of Aug. Bonnet a great number passed out of the artificial opening in the right hypochondriac region. The patient of Thélésius passed from an abscess of the liver, 500 to 600 small calculi in the period of nine years. In the case of Grandclaude, the first calculus which passed through the abdominal parietes was of the size of a pigeon's egg; in the case of Klemm, however, a calculus was extracted, which had the enormous size of a goose's egg; in the observation of Meersman, the calculus was 8 centimètres in length and a little more than 2 centimètres in thickness.

When the calculi leave the gall-bladder by an opening in the fundus, they mostly penetrate the abdominal wall in a most direct manner. Sometimes, however, as in the case of Grandclaude, they pass first into the liver, causing abscess there, or passing into an abscess already formed in consequence of the irritation and inflammation caused by their presence in the gall-bladder. The abscess may then produce its own discharge by a separate opening, and two or more fistulæ may be the result. The external aperture of the fistula is therefore seated in different places, according to the peculiar diversion which the abscess or calculus experienced. It is mostly immediately underneath the border of the false ribs, corresponding to the situation of the fundus of the bladder. Next to this its seat is most commonly the umbilicus, and then it may be assumed that the calculus or abscess has travelled along the round ligament, or the cellular tissue surrounding the former umbilical vein. Sometimes the abscess opens to the left of the umbilicus.

Several cases are known in which the abscess healed up immediately after the calculi and the accompanying pus and bile had been discharged. In other cases the passages remained open, discharging various matters, and constituting chronic fistulæ. Their outer apertures become retracted, and their passages very narrow, tortuous, with sinuses and bifurcations, as in the case of Saurau. The fistula may have an extraordinary length, up to 10 centimètres, which was its length in the case of Petit; it may become very callous and unyielding. Under these circumstances, calculi coming down from the gall-bladder have been observed to be retained, and probably to increase in size, so that the fistula ultimately contained a concretion 8 centimètres long by 6 centimètres in circumference, as in the case of Saurau. The calculus may become fixed in the canal, as in a case of Petit's, in which ragged ends of cellular tissue were imbedded in little cavities at the end of a calculus, and tied it firmly to its place in the morbid cyst.

A large number of cases recover perfectly, others recover for a time and have relapses; some retain a fistulous opening for life, which makes existence troublesome, but does not always shorten its term. In a few cases, death results rapidly under gastric symptoms, fever, hectic, and in a very small number of instances the disease lasted, with exacerbations and remissions for many years, ending life by marasmus.

After death, it is most difficult to distinguish the tracts of abscess and calculi, as the several organs are so intimately grown together that separation is impracticable. The gall-bladder is mostly gone, as in the case of Andral, where it could not be distinguished. The liver may be shrunk, and variously altered, particularly engorged with inflammatory effusion, or destroyed in part by abscess or ulceration. In some cases, where only pus and serous matter, or bile, but no calculi, were discharged through the outer aperture, the gall-bladder was found filled with calculi, with only a small aperture, mostly in the fundus; in other cases the gall-bladder retained yet some calculi, although a portion of those originally contained in it had been discharged by the fistula.

Cases.

Biliary calculi passed from a fistula; recovery.—Susannah Walker, aged sixty years, was admitted into the London Hospital the 27th of March, 1813, on account of a fistulous opening, situated midway of the navel and pubes, from which, she stated, had passed, some time in the last summer, within the space of a week, three stones of the appearance of chestnuts, of the size each of a small nutmeg.

She had for nearly a year experienced pain in the abdomen, especially near the affected part, but had never suffered particularly in the region of the liver, nor had she ever been jaundiced or subject to any complaint, only had been habitually costive.

A probe upon introduction passed freely in a sinus, obliquely to the right upwards, and at about the depth of two inches from the surface of the skin, struck against a hard body, whereupon the passage was enlarged, and by it extracted a stone, apparently biliary, of the size of a small walnut, and which the woman said resembled the three stones which were discharged in the summer.

The wound healed kindly, and in a month the patient was dismissed cured.

The central portion of this calculus consisted of cholesterine mixed with the colouring matter of the bile, while the exterior was composed of nearly pure cholesterine. The smaller extremity of the calculus was concave and smooth, as if produced by contact with another stone. It was presented to the Museum of the College by Sir William Blizard, in 1813. ('Catalogue of the Calculi,' &c., p. 172.)

Case of the Bishop of Chichester.—Under A. 81 of the College Museum, p. 176 of the Catalogue, are described two large calculi presented by William Guy, Esq., in 1844, consisting of impure cholesterine. One of these has been divided, it is of a cylindrical figure, and has mutually adapted surfaces at each end. It measures about one inch and a half in length by one inch across, and weighs rather more than half an ounce. The other is nearly globular, and weighs rather less than two drachms.

These calculi were expelled through a fistulous opening in the parietes of the abdomen, communicating with the gall-bladder, many years before the death of the patient (the Bishop of Chichester), from whom also was taken the preparation in the museum of a pouch in the œsophagus. The opening in the abdomen remained for a considerable time, but finally closed. The following account of the state of the parts accompanied the calculus:

"Immediately opposite to an external cicatrix, formed by the passage through which the gall-stones had escaped, the fundus of the gall-bladder adhered closely and firmly to the peritoneum, and, instead of occupying its proper situation under the liver, lay strongly stretched over its surface, the latter being greatly diminished in size. No bile was contained in the gall-bladder, but about a small teaspoonful of fluid, both colourless and tasteless. As its duct was obliterated, it would appear to have been long since a useless appendage to the system. The patient died at the advanced age of ninety."

Case of biliary fistula from a gall-bladder filled with gall-stones, no calculi being discharged by it.

The gall-bladder of Dr. Walter Charlton was found full of angular gall-stones. The end of it was joined to the peritoneum, from whence gall was discharged by a tumour which turned to an ulcer in the side. The calculi were small cholesterine concretions, and were given by a Mr. Cowper to the collector of the Sloanian Museum. From that collection they emigrated into the British Museum, and thence into that of the College of Surgeons. (A. 95, 'Catal.', p. 178.)

A case of a large gall-stone escaping through the walls of the abdomen after many months' suffering, with ultimate recovery. By DRAPER MACKINDER, M.D., F.R.C.S. ('British Medical Journal,' December 26th, 1857.)

The author was, on August 28th, 1856, requested to visit

Mrs. B—, a delicate lady, aged seventy-five, who had frequently complained of a pain in her right side, but now seemed to be suffering from an attack of acute hepatitis; he attended until October 23rd, when she became convalescent.

On February 7th, 1857, she sent for some medicine to relieve a pain in her side, and nine days afterwards he was requested to see her in consequence of an aggravation of her symptoms. He found her suffering much from pain in her right hypochondrium, increased by pressure; a difficulty of breathing; a dry, furred tongue; thirst, vomiting; a quick, feeble pulse; and a distinctly circumscribed hardness at the inferior border of the liver, movable like a tumour, and exquisitely sensitive. As time advanced, this tumour descended along the external margin of the right rectus to the superior boundary of the iliac region. Here the integuments became inflamed, and fluctuation was soon perceptible over a radius of three inches, and on March 3rd the abscess burst, and gave exit to about three ounces of pus. At the end of April a hard substance, of the size and configuration of a hen's egg, was perceptible to the touch, an inch above the opening; but the integuments for four inches around were hardened, nodulated, red, and so very painful that a proper exploration was not permitted. Poultices were ordered to be applied, and tonics and liberal diet were administered, the patient's debility requiring the recumbent position. Early in May, while she was standing by her bed, the hard substance, before mentioned, suddenly rolled on the floor, having escaped through the abdominal wall at the middle of the right iliac region. It proved to be a large, ovoid gall-stone, very hard, weighing six drachms, measuring two inches by one and a half, and exhibiting, on fracture, a beautiful crystalline composition, of a nearly pure cholesterine in the centre, with a thick coating of colouring matter, and carbonate and phosphate of lime. The old lady is now in capital health.

Gall-stones voided through the abdominal parietes. By JOSEPH HINTON, Esq. ('British Medical Journal,' August 4th, 1860, p. 603.)

Sarah Allen, aged sixty-seven, a pauper, came under Mr. Hinton's notice for the first time in February of the year 1860, at which time mere dyspeptic symptoms were complained of. These yielded readily to appropriate treatment.

In the early part of March she was represented as being very much worse, and then the author gleaned the following history. She had always been a very healthy, hardworking woman, never having laid by except during her confinements; these, however, had been difficult, occasionally requiring instruments. He could not trace any attack simulating gall-stones. She was now partially insensible; the head hot; the skin dry; there was also slight œdema of the legs. He found the bowels sluggish; the urine was scanty, rather high-coloured and turbid, and highly albuminous. Free purgation, antimonial salines, dry cupping to the loins, coupled with blisters to the nape of the neck and neighbouring parts, relieved her considerably. The urine recovered its natural appearance, and the albumen disappeared; but as the head-symptoms left her she had a hard attack of peritonitis, the abdomen being for several days remarkably tense and tender on pressure. Mercury and opium were freely administered with great benefit; when, towards the end of March, and during, as it seemed, a convalescence, the glands around the jaw and down the sides of the neck became frightfully enlarged, and of almost stony hardness. In a few days they suppurated, opening in numbers of places, and discharging thin, unhealthy pus. The general powers now began to fail; the tongue was dry; the pulse quick and feeble. Quinine, port wine, and beef tea were continually given, and she commenced slowly to rally.

On one of the author's visits, in the early part of April, she complained of soreness at the umbilicus, and he found beneath this point a small swelling, the skin discoloured, and indistinct fluctuation. In general condition, she was improving. He ordered this to be fomented and poulticed. Two days afterwards he was hastily summoned. The friends appeared in great alarm, and told him they had followed his directions. The abscess had burst, and now, to use their own expression, "her business came out there." She was certainly in no worse condition as to general strength, but there had been a copious discharge of dark pus from the abscess. As far as appearances went, this matter evidently contained bile, and was not feculent in odour.

The old woman continued to improve, fed well, and slept fairly, while the tongue lost its dry, hard coat, and very gradually moistened. About a week after the bursting of the abscess nine or ten small gall-stones passed through the wound. On his next visit, two days afterwards, thirty-nine more were given him, some of which were large. Ten or twenty more were passed at varying intervals, the wound sometimes appearing healed. On one occasion he endeavoured to discover the direction of the passage with a warmed gum-elastic catheter, but could not succeed. The opening was generally filled with a large granulation, and appeared valvular.

Steady progress was now made. The wound closed up in the beginning of June; the abscess in the neck healed, leaving, of course, some amount of induration. She was able to sit up in bed, and, seated in a chair, was carried to her daughter's house; he now considered her comparatively well. The completion, however, was close at hand. On the 2nd of July, after complaining of headache, she was seized with convulsions, from which she never rallied, dying in about thirty-six hours. Some urine, not very clear, which she passed before insensibility became complete, was clouded by heat. No treatment appeared to have any influence.

Post-mortem examination, sixty hours after death.—The abdomen only was examined. In making the incision, he deviated from the usual course, so as to leave an inch of integument around the umbilicus. Peritoneal adhesions existed all over the surface of the liver, but they were easily broken down. The two lobes of the liver were united by adhesions around the round ligament, which appeared free from disease and unconnected with the umbilical mischief. The gall-bladder was considerably below the anterior border of the liver, and was attached by adhesions to the umbilicus. There had evidently been direct communication; but, on careful dissection, he could find no actual canal, and presumed that it was obliterated. The gall-bladder still contained from fifteen to twenty stones. The whole of the tissues around the umbilicus and among the adhesions were filled with dark pigment. The liver itself was large and fatty. The kidneys were both advanced in disease, and there was very little difference between the cortical and internal portions. No adhesions existed between the intestines. The head was not examined.

Biliary calculi discharged from the right hypochondriac region; recovery.

At a meeting of the London Medical Society, on May 16th, 1828, Mr. Callaway exhibited two biliary calculi, each of the size of a hazel-nut. The patient, a woman forty-nine years of age, had a tumour in the right hypochondrium, which eventually matured; ill-conditioned pus, mingled with bilious matter, was discharged, and shortly afterwards one of the calculi. A fortnight subsequently the second calculus was discharged; the wound eventually healed, and the patient did well. She was under the care of Mr. Ravis, of Union Street, Borough. ('The Lancet,' 1827-28, ii, 296.)

Case in which calculi were discharged from the umbilicus. By H. C. Stewart. ('The Lancet,' September 15th, 1849, p. 294.)

A baker, aged forty, tall and spare, was, in the month of February, 1849, attacked with pain in the abdomen, which, becoming constant and severe, caused him to apply to the author. He was first visited on February 12th, and was found sitting in an arm-chair, with his hands resting upon his knees. He was pale, and his features bore the expression of long-continued pain; he had frequent shivering, though his skin was hot and dry to the touch. He complained of nausea and thirst, constant pain in the region of the umbilicus, extending for about two inches all round it, of a pricking character, with occasional severe stabs of pain darting from the umbilicus to the back. The pains were slightly increased by pressure. Though the bowels had been relieved twice the day before, he was ordered to take a purgative draught and to apply hot poppy fomentations to the abdomen.

On the next day he had obtained no relief, and on examination in daylight the author discovered, just below the umbilicus, and a little to the right side, in the position of the obliterated right umbilical artery, a circumscribed hardness, about an inch in length and about half an inch in breadth; its surface was very slightly elevated and not discoloured, but very painful to the touch, and occasionally throbbing. The patient felt more nausea and thirst, his skin was hot and dry, and he had frequent shivering. A blister was ordered to be applied to the seat of pain, and a cathartic draught was administered.

On the 14th he had obtained some relief, and had lost the severer part of his pains. On the 15th he had passed a better night, as the pain in the abdomen was almost gone. On the 16th he was better in every respect, but, owing, perhaps, to the action of the purgatives, felt low and weak. The blister was healing, but there was a slight discharge of yellowish-green pus from the umbilicus, which latter was very red and tender, and slightly protruding. A bread-and-water poultice was applied. When this was changed on the morning of the 18th, the navel protruded very much, was swollen and red, and discharged pus freely; in the pus upon the poultice a hardish substance, of the size of a hazel-nut and of whitish colour, was found, which proved to be a calculus composed of phosphate and carbonate of lime.

On the 19th he passed several smaller calculi, of the size of poppy-seeds, but they were all thrown away. The umbilicus was receding. On the 20th he was able to sit up; the umbilicus was less prominent; he passed not any more calculi. On the 22nd he was convalescent, and on the 28th he was quite well.

Gall-stones discharged from a cholecystic fistula; recovery.
('Med. Times and Gaz.', May 10th, 1862.)

Hannah E—, aged fifty-nine, widow, of sedentary habits, was admitted under the care of Dr. Cockle, at the Royal Free Hospital, towards the end of 1861, with the following history. She came of healthy family, and always enjoyed good health, with the exception of occasional pain and tenderness over the right side.

About nine days before her admission the pain in the side returned with unusual severity. It began soon after dinner, at the pit of the stomach, and extended over the entire body and side of the neck. She felt very chilly, and retched violently.

She is quite sure she was not jaundiced, and the state of her bowels was natural, but she remarked that her urine was dark in colour. After a day or two the violent pain and sickness abated, but there remained great tenderness and a swelling at her right side. Over this the skin became red and inflamed, and in less than a week after it burst, and a considerable quantity of green matter escaped, with about fourteen angular calculi, apparently composed of cholesterine, with striæ of pigment-matter.

In the subsequent poultices three more calculi passed. The redness of skin and tenderness now rapidly abated, leaving an opening the size of a crow's quill, situate about two inches in a slightly oblique line below the umbilicus. From the orifice was a constant oozing of nearly colourless mucus, which was somewhat increased upon pressure from above. A probe introduced readily passed obliquely upwards for nearly two and a half inches, when it came in contact with a solid body. Palpation, corresponding to this point, easily detected a firm tumour about the size of a small hen's egg. Percussion, however, did not determine the peculiar chink occasionally met with where calculi exist in the gall-bladder. The liver was very considerably enlarged. After some time she complained of pain and tenderness over the old spot, and a calculus was felt by the probe about one inch and a quarter from the orifice, and the skin again began to redden. After several ineffectual attempts on successive days to extract it with the dilating forceps Mr. Hill had constructed expressly, Dr. Cockle was compelled to slit up the sinus as far as the stone, and readily removed it. It was the largest of the series. The wound quickly healed, and the sinus seemed for two or three weeks almost entirely closed. At the end of this time the old symptoms returned, and another calculus was detected about two inches distant from the outer orifice. Mr. Hill again tried to dilate the sinus and grasp the stone, but after a few attempts so much tenderness and purulent discharge followed that it was not considered safe to interfere further at present. Recently these signs have ceased, and the fistula has again relapsed into its former indolent state, contracting, and only discharging nearly colourless mucus. The patient has now returned to her ordinary occupation; but there can be no doubt that the sinus will again open from time to time, as many calculi are still in the gall-bladder. Dr. Cockle remarks that, considering the difficulty of determining the amount of adhesion existing in such cases, we must be extremely careful to use only the gentlest means in endeavouring to extract a calculus when high in the fistulous canal, whatever the amount of local irritation present. In a similar case, under the care of M. Robert, at the Hôtel Dieu, the attempt at extraction induced, from the disturbance of the adhesions, fatal peritonitis. In the case of Hannah E— the fluid obtained by pressure from the parts exhibited, under the microscope, numerous mucous or pus-corpuscles, but no bile-cell or cylinder epithelium; and, on using the ordinary test of nitric acid, no evidence of biliary colouring matter was obtained, corroborative proof of the entire closure of the cystic duct.

Passage of Gall-stones through internal Biliary Fistulæ.

In a former paragraph we have already seen that large calculi mostly make their way from the gall-bladder into the duodenum by an abnormal passage produced by ulceration of the united walls of the bladder and duodenum. The symptoms denoting this process are extremely obscure, but they are mostly proceeding from continued pain in the regions involved in the process, which pain radiates towards the right shoulder and other parts of the abdomen. Vomiting is sometimes present. In a case observed by Cosseret ('Bullet. de Thérapeut.', 1845) there was at first a hard swelling perceptible in the right hypochondrium, which disappeared gradually.

Cases in which the existence of a cystico-duodenal fistula has been found after death are rare. To this category belongs the case by Monod, already referred to in the paragraph on obstruction of the jejunum; the case related by Brayne, in 'Med.-Chir. Transact.', 1823, 12, 225, in which the existence of a ligamentous union between bladder and gut denoted the direction of the fistula, through which two large calculi were supposed to have passed; a third case is recorded by Reynaud, in 'Journ. hebd. de Méd.', 1829, No. 51, p. 490; a fourth by Porral, in the same journal, same year, No. 50, p. 473; a sixth case is that of Renaud and Reignier, given at length under the paragraph treating of intestinal obstruction produced by biliary calculi; a case by Corsy is recorded in the 'Bullet. de Thérapeut.' for 1845; and one by Corbin is given by Fauconneau-Dufresne. The case of impacted calculus which I have described deserves also to be mentioned as an instructive example of cystico-duodenal fistula.

But although anatomical data of this lesion are rare, we are nevertheless obliged to assume its frequent occurrence in order to be able to explain the passage into the intestine of those larger or enormous concretions which, we have seen, are in many cases successfully expelled from the body.

A few symptoms are known, observed in single cases, which can support the hypothesis of the existence of this fistula in other given cases. In one instance related by Frerichs, in which the ulceration proceeded from the common duct and terminated as an abnormal passage in the duodenum, there were bloody stools. In the second case of Frerichs, where an abnormal communication existed between the gall-bladder and the duodenum, no calculus had actually been found either during life or after death, but its presence has been merely surmised, and apparently with reason. In this latter case however, not a single symptom denoted the existence of the particular lesion concerning the gall-bladder and gut.

A case in which the gall-bladder communicated by a false passage with the colon is given by Fauconneau-Dufresne, after M. Durand, interne at the Salpêtrière. The passage seems to have been the result of cancerous ulceration, and not of obstruction or ulceration caused by gall-stones, although the hepatic duct was closed by a gall-stone of the size of a bean, which had produced a high degree of jaundice.

Cases in which gall-stones have passed from the gall-bladder into the cavity of an abscess of the liver have already been mentioned. A case of this kind is reported to have been observed by J. P. Frank. Rondeletius ('Method. curand. morbor,' cap. 44, quoted by Schenckius, 3, 394, obs. 13, "Lapides in abscessu hepatis notati") observed a case belonging to this category; calculi like bones, of a yellow-red colour, were discharged from an abscess of the liver in the mother of a most learned man at Nemours. The passage of gall-stones into the portal vein, which is alleged by all modern writers to have been observed upon Ignatius Loyola, the founder of the order of the Jesuits, is a myth, as has already been shown in the digest of historical literature. The case related by Francis Devay in the 'Gaz. Méd. de Paris' du 20 Avril, 1843, and which this author and Fauconneau-Dufresne claim to be one in which a biliary calculus was formed in the blood of the portal vein, does certainly not admit of that conjecture. The calculus found in the enlarged portal vein, just before it enters the liver, probably came there by a most gradual process of wearing of the biliary passages from which it started, and of the walls of the vein which it entered. Though even then it is difficult to explain how the calculus, consisting of the ordinary ingredients of gall-stones—cholesterine, pigment, stearine, green resinous matter, picromel, and salt of magnesia—should have assumed the cylindrical form and a length of upwards of two centimètres; and still more difficult is it to explain how the cylindrical bodies in the branches of the portal vein within the liver should have come there. However, as there had been jaundice during seven years, and disease in the region of the liver during a much longer period, and as the liver was small and soft, the assumption that these calculi formed originally in the now obliterated biliary passages and gall-bladder, which latter still contained a calculus, and thence passed by a chronic process to the places where they were found, is still the most probable of any that can at all be entertained.

The case related by Jacob Camnicenus, quoted by Phoebus ('De Concrementis Venarum Osseis et Calculosis,' Berol., 1832, p. 44), was that of a man who, after long-continued jaundice, fell into a dropsy; the branches of the portal vein were found entirely filled with calculi, which were black externally and yellow in their interior; a similar concretion was found in the common duct. Here also the belief is hardly to be avoided that the concretion passed into the portal vein from the biliary passages. The succession of symptoms, also, and the presence of dropsy, which, strange enough, was absent in the case of Devay, notwithstanding the enormous dilatation of the portal vein and the enlargement of the spleen, support the explanation that these calculi were biliary, and passed mechanically into the vein.

In some rare cases calculi of undoubted biliary origin have made their way into the urinary bladder and been discharged through the urethra. Such were the two following cases of—

Expulsion of gallstones by the urinary passages.

Gabr. Pelletan ('Journ. de Chim. méd.')—A married woman, about thirty-seven years of age, of a nervo-bilious, delicate constitution, who was regularly and copiously menstruated, and generally enjoyed pretty good health, suffered of daily hemicrania, accompanied with frequent bilious vomiting. She had never suffered of jaundice, never had had tumefaction of the liver, and never had laboured under any attacks of inflammation and swelling in the right hypochondriac region which could have led to the suspicion that there was any communication between a supposed purulent deposit in the liver, or a hydatid cyst, or the gall-bladder, on the one side, and the kidneys or the ureters on the other.

For two years this person had felt a dull pain and a sensation of heaviness on the right side just above the fossa iliaca, and some tumefaction could be perceived in the place. She suffered of short breathing. These symptoms increased daily, so that she was at last obliged to remain in bed. The urine, which up to that time had passed with ease, began all at once to be obstructed at times, and could only be made to flow again by a change of the posture of the body; at the same time there was a necessity for frequent micturition. At last small calculi were evacuated with the urine, their number within a week amounting to about two hundred, after which there was a remission of symptoms.

The calculi were all of the same nature, but of different sizes. One large calculus remained fixed in the neck of the bladder, and had to be removed. The colour of the concretions was greenish outside; they had a soapy feel, and in shape were polygones, with their edges rounded off. Their cortical layers were of uniform thickness; their nuclei were brown, and served as starting-points for crystalline needles, which projected like rays towards the periphery. Their specific gravity amounted to 1·213, or even 1·966. They consisted of—cholesterine, 95; the other 5 parts were made up of biliary colouring matter, animal matter, and little uric acid.

The urine during the time these calculi passed was dark yellow, and though at first it appeared to contain cholesterine, yet on repeated examination it was not found to be present.

Faber ('On the Passage of Gall-stones through the Urinary Channels,' Tübingen, 1839, L. T. Fues).—A housekeeper, aged forty, had never suffered of jaundice or any other serious illness. In the early part of the year 1834 she became the subject of rheumatic fever, and towards the end of that year of an abdominal inflammation. Since that time she frequently felt a pressure in the pelvic region, to which, however, she paid no attention.

On the 13th of October, 1835, she again became ill, with cough and chest complaint, accompanied by fever. After some days there appeared pain in the pubic region, which was not augmented by external pressure, but became worse when she sat up in bed. The urine at the same time had assumed a blackish-green colour. This colour remained during several days, during which several gall-stones were evacuated from the bladder. The urine then became brownish, afterwards orange yellow, and on standing deposited a yellowish-white sediment. At the same time the symptoms subsided. On the 23rd of October there appeared again severe pains in the chest, and difficulty of respiration, but no difficulty of micturition. On the 24th the urine became again greenish yellow. On the 26th it was passed with difficulty, and formed a brownish-yellow sediment, at the same time the patient complained again of pain in the pelvic region. On the 30th a small calculus passed per urethram, and on the following day several more. After this there was again a remission of the symptoms, so that the patient could follow her usual avocation. The urine, however, remained more or less greenish, and lost this colour only in February, 1836. Towards the end of that year the urine became again blackish green, and some calculi were discharged with it; the suffering in the urinary organs persisted from that time through the winter, and in May, 1837, the patient was compelled to undergo the operation of urethrotomy for the removal of a calculus, which was three times as large as any of the others. The patient now went to the hot springs of Wildbad, and was much benefited. In the following September another secession of calculi took place, and another in April, 1838. She visited the thermal springs of Wildbad a second time, and in July was, without any difficulty, relieved of the last of the calculi, and recovered her former perfect health.

The weight of the smaller calculi amounted to seven or eight grains each, the larger ones weighed from forty to forty-four grains each. They were multangular; their edges were rounded off; their colour was yellow, with dark-brown spots. On the surface of a section they exhibited consecutive layers of yellow and brownish-yellow colour. Any particular nucleus of a peculiar substance could not be observed. They were analysed by L. Gmelin, who found them to consist of—

Cholesterine	93·9
Green with little brown colouring matter, carbonate and phosphate of lime	6·1
	100·0

The urine contained the ingredients peculiar to it, and some biliary matters and cholesterine.

There can be no doubt that these calculi were originally formed in the biliary organs, particularly the gall-bladder, and thence passed either in or along the ureter, or along the ligament representing the urachus into the urinary bladder. As the passage of gall-stones to the umbilicus is not a rare occurrence, it is not difficult to comprehend that, instead of being excluded at the navel, they should sink along the urachus, and ultimately pass into the bladder. However that may be, the hypothesis made by Bouisson, (66), that these calculi are formed in the urinary passages from biliary colouring matter excreted by the kidneys, and, therefore, always contain a larger or smaller quantity of the ingredients of the urine, and can, therefore, not properly be considered as mere gall-stones, is quite untenable.

A case of Platerus, concerning a man who had been jaundiced and cachectic, with pain in the region of the liver on pressure, and had recovered after evacuation of gravel with the urine, admits of some doubt, though it is possible that the gravel, if it was biliary, descended along the ureter or urachus into the bladder.

In conclusion, I shall have to relate two cases of escape of gall-stones into the peritoneal cavity. In the first case the gall-stones, if the concretions found were in reality such, which does not seem to be well proved, must have been in the cavity of the intestine at the time the rupture took place.

Fatal Case of escape of Gall-stones into the Peritoneal Cavity. By FREDERICK W. MARSHALL, M.B. London. 'Lancet,' July 15th, 1848, p. 67.

John F—, aged twenty-two, a worker in a stone-delph, of temperate habits, and general robust health, got drunk with three pints of public-house beer, on May 1st, which caused vomiting, pain in the right shoulder, and general indisposition. He had, since this "bellywarch," occasionally felt ill, till Tuesday, May 9th, when, being at work, he felt a sudden severe pain in the left iliac region, with desire to go to stool. The pain increased while evacuating the bowels; the dejections were like oatmeal porridge. He went home and vomited, being "bent double" with the pain. It increased till 10 p.m., when Mr. Marshall first saw him. Symptoms: pulse not quickened; tongue not furred; no headache or aching of limbs; considerable thirst; anxious countenance; abdomen hard, particularly in the seat of pain, where there is much tenderness; the pain occurs in exacerbations, which are also brought on by movement; there is frequent and ineffectual desire to pass fæces.

These symptoms continued till Sunday, the 14th, when the strength became prostrated, in spite of stimulants and nourishment. Great coldness of extremities; sleeplessness;

slight delirium: no vomiting since the first day. In the afternoon of Tuesday, the 16th, he died.

The treatment adopted consisted of venesection, leeches, cupping, castor-oil, followed by opium in large doses, with small quantities of mercury pill, enemata, fomentations. The cupping gave the greatest relief, enabling him to lie on the left side of the body without pain for six hours, after which it returned as before. The opium failed to produce sleep, except for a few minutes, which the patient believed to be as many hours.

Post-mortem examination forty-eight hours afterwards.—Abdomen very tense; a little clear yellow serum escaped from the first incision. At the right iliac region, close to the appendix vermiformis (which was glued to the parietes with lymph of a greenish colour), were found two gall-stones, one weighing five grains and a half, the other one grain and three quarters, quite loose in the peritoneal cavity. Much greenish lymph was effused on the neighbouring viscera. On following the effusion upwards, it led to the pyloric extremity of the stomach, on the greater curve of which, about one inch and a half from the pylorus, was found a large valvular opening, from which the contents of the stomach gushed upon the slightest pressure.

The escape of a Calculus from the Gall-bladder into the Abdominal Cavity. (Letter from Mr. John Sharman to the Editor of the 'Medical Times and Gazette,' March 12, 1859, p. 274.)

Recently in a female brought into the anatomical room of the London Hospital, there was found by one of the pupils (Mr. Little) a calculus of the size of a blackbird's egg, located at the acute margin of the liver, and surrounded by a firm cyst in close proximity to the gall-bladder.

The peritoneum had been the seat of old inflammation, as evidenced by firm adhesions of the intestines to the great omentum, as also to each other. The peritonitis was probably an extension of the local inflammation which was established by the stone perforating the coats of the gall-bladder.

Diagnosis.

The disease which gives rise to gall-stones cannot yet be distinguished from among the numerous varieties of disorders of the stomach and intestines. It begins, no doubt, with an acute disorder, which afterwards passes into a chronic state. The disorder itself may probably sometimes pass over without leaving gall-stones behind.

Gall-stones, once formed, may remain latent for a shorter or longer period, frequently for life, or may be passed without any symptom whatsoever. The absence of symptoms, therefore, is no proof of the absence of gall-stones.

Calculi in the hepatic ducts are most difficult to diagnose, as they cause attacks resembling intermittent fever so closely, that the most expert physicians have been deceived by them.

Calculi in the gall-bladder, when not producing symptoms, can sometimes be felt through the abdominal parietes, particularly when their number is great and their size is large, and there is sufficient fluid in the gall-bladder to admit of their moving readily from one place to another.

When symptoms of the passage of gall-stones begin, there can generally be little doubt about the matter. Gall-stone colic cannot easily be confounded with any other disease, and other diseases, including true colic itself, have generally little resemblance to gall-stone colic.

When the calculus becomes impacted in the cystic duct, and the gall-bladder, nevertheless, continues to pour out its ordinary secretion, a rapid distension of this organ supervenes, which can readily be ascertained by palpation. This distension, without jaundice following upon the colic, is pathognomonic.

Pain, by its seat, is the most characteristic sign of the disease, shivering and rigor precede or follow the first onset of pain. Pathognomonic is the retardation of the pulse. Jaundice is often absent, but when present is a most valuable, and frequently pathognomonic sign of gall-stone disease.

Gall-stone colic can be distinguished from certain diseases of the stomach involving pain by the circumstance, that in the former, pain begins only some hours after the taking of food, while in the latter, pain is the immediate consequence of the taking of food. Moreover, the pulse is fast in gastric disease.

Treatment of Gall-stone Disease.

Gall-stone disease comes most commonly under medical treatment at the time of the passage of calculi through the biliary conduits. The physician is hurriedly called to a patient who has been rather suddenly seized with the usual symptoms, and on his arrival at the bedside he is at once urged both by the patient and those around him, to relieve the pain. It is under all circumstances reasonable to promise to act in that direction, but the manner and the time in which the object has to be attained vary according to circumstances, to which the closest attention has to be paid. In some few cases it is necessary to act most energetically and without loss of time, to prevent death from the mere pain caused by the gall-stones. In the course of this autumn a case has come under my notice, in which a gentleman was one evening seized with gall-stone colic. He was relieved by proper treatment. A few days later he was again seized during the night, with more violent colics than he had had before. His medical attendant had scarcely arrived and taken the necessary steps to relieve the sufferer, when he perceived that the patient was sinking. It may therefore be required to leave remedies, and directions for using them, with persons who have once had serious gall-stone colic, in order that in case of any sudden return they may be employed without loss of time. For the relief of this pain, a mixture of anæsthetic and anodyne remedies has appeared to me the most useful. Both chloroform and ether act rapidly when taken in the stomach, and when this is impossible on account of sickness, they can be administered upon a pocket-handkerchief and inhaled into the lungs. Morphia and opium soothe the pain for a much longer time than either of the two volatile anæsthetics, but they also require a much longer time before they take effect, particularly in cases where the pains have come on a few hours after a large meal, and the stomach is full of half-digested matter. When vomiting has set in, and sickness threatens to continue, the opiates have to be administered by the rectum.

One of the most difficult points in practice is the adjustment of the dose for every given case, so that on the one hand the pain shall be effectually relieved or mitigated, and on the other no narcotic symptoms of an annoying nature shall succeed the cessation of the pains. This difficulty arises from the circumstance, that in some persons the pain and irritation caused by the gall-stones is of such an overwhelming nature as to be scarcely affected even by large doses of anodynes, more particularly tincture of opium given alone, or morphia administered in solution. If it happens that after the ingestion of these large doses of drugs the pain, by virtue of the drugs or by other circumstances, such as the return or discharge of the calculus, suddenly ceases, the symptoms of poisoning by opium do not fail to make their appearance, and cause a disagreeable, and sometimes dangerous condition of the patient. This occurred a few years ago to a Member of Parliament then residing in Ireland. Owing to the most urgent requests of the patient, who was writhing with agony, the medical attendant had administered large doses of tincture of opium on several days during which the colic continued. At last a sudden cessation of symptoms took place, and the patient became unconscious and sank into a deep narcotism. From this he was roused by the usual applications, slapping of the body with the hands, cold wet sheets, beating of the surface with sticks, and other means. He was saved from the narcotism, but not from the consequences of the treatment which had saved him. For he died a few days later from the combined effects of the primary pain, the narcotism, and the severe treatment which the latter had necessitated. His case became the subject of a judicial inquiry, which exonerated the medical gentleman from the charge of negligence which had been brought against him. The evidence of several members of the medical profession adduced in his behalf on that occasion, showed that cases in which opium produces unexpected narcotism are not so very rare. The case, therefore, and the evidence elicited by it, suggest great caution in the administration of opium and its alkaloids.

It is, under all circumstances, advisable that the practitioner, when once at the bedside of a patient with severe colic, should remain there, and administer the medicines himself, until some relief has been obtained. He may administer twenty minims of chloroform upon a piece of sugar to be washed down with the necessary quantity of water. This may be repeated every twenty minutes, until a drachm has been used. If the patient is inclined to be sick, the taste and salivation excited by the chloroform are apt to cause an increase of the sickness, or to produce vomiting. This should be foreseen, and slightly alluded to as possible in the conversation with the patient. It is not to be regretted, but necessitates the application of the remedy by inhalation, or its entire abandonment. Along with the chloroform a solution of morphia may be given; one eighth of a grain every half hour, or, according to circumstances, at longer intervals, until half a grain, in strong and hale persons up to a grain has been given, is a proper dose. Laudanum must be given more empirically in doses of from five to ten minims at proper intervals, largely diluted with water, as its effects vary more than those of the solution of morphia.

The anodyne effect of the chloroform can also be obtained by sulphuric ether, which, like chloroform, may be used mixed with equal parts, by measure, of the strongest spirit of wine. This anodyne liquor of Hoffmann is also best taken upon sugar, in small, often-repeated doses. It is not so apt to favour vomiting as chloroform, and in cases of lowness of the vital powers has a most satisfactory collateral effect upon the pulse, and the powers of the voluntary muscles.

The proper combination of these remedies seldom fails to produce a period of decided relief, which must be used for the administration of a purgative medicine and a purgative enema. Castor-oil on hot milk, in cases where no sickness threatens, is very useful. Where sickness is felt, Seidlitz powders dissolved in considerable quantities of water, so as to make the taste purely agreeable, should be given. In this way these powders also act quicker than when they are taken in too small a quantity of water. But in cases where any taste produces nausea, and where constipation has been preceding the attacks for some time, cathartics must be administered in the form of pills. Ten grains of jalapine, in pills with conserve of roses, is a useful formula, which I have even found successful in a case of severe vomiting, which was with difficulty mitigated by five minim doses of dilute hydrocyanic acid in iced soda-water repeated at short intervals.

In simple cases, after mitigation or cessation of the pain, the patient generally falls asleep. He awakes after a few hours, either from exacerbation of the colic or for the satisfaction of the call of his intestines. The urine which is passed after or during the colic is mostly red, and deposits a great cloud, and thick crust of pink and buff urates. If the pain returns, the anodyne treatment, but with greater care, will have again to be adopted. The doses of medicine should be small, dilute, and given at longer intervals. In no case has the pharmaco-dynamic limit to be exceeded. When on the other hand the bowels act, care has to be taken that the stools are kept for inspection as to shape, size, colour, and quantity, and that they are afterwards put on a tammy and washed on the pan of the water-closet in a stream of water, with the assistance of a broom of straw or a similarly useful instrument.

In cases where purgatives cause vomiting, even when joined with large and repeated enemas of water, with salt, and castor-oil, and where, in consequence of the effect of the opium, the bowels remain confined, the extract of belladonna, or what is preferable, an infusion of belladonna leaves (nine grains of the comminuted leaves upon three ounces of water) may be given. This relieves not only spasms but also pain in some measure. It is not only useful in cases of spasm of the biliary ducts, but also in that spasm of the intestines where a calculus is retained, and obstructs mechanically the passage of their contents. When the infusion of belladonna has to be repeated once or several times, it causes the peculiar effects indicating the toxic action of this drug, such as large pupils and intermittent delirium. The extract, in an ointment, may be applied to the skin on the abdomen, in cases where it is desired to have the effect slight and gradual. Better than either infusion or extract is the solution of the pure alkaloid atropia.

Vomiting, so long as it removes the contents of the stomach which remained from the last meal, is salutary, and does not call for any interference. But when it passes into retching of a painful nature, and threatens to lower the vital powers, it must be counteracted. Small doses of strongly effervescing soda-water, containing a small excess of soda to neutralise the acidity of the stomach, which sets the teeth on edge; draughts of pure cold water, iced water, and, best of all, lumps of ice rapidly crushed between the teeth and swallowed; effervescent draughts with prussic acid in more obstinate cases, joined with the cold water and ice, are mostly effectual in removing this symptom.

It has often been asserted that vomiting, either spontaneous or excited by emetics, assists the passage of the calculus through the bile-ducts. This may be explained by the assumption, that when, after long compression of the contents of the abdomen a rush of fluid at last takes place through the aperture of the œsophagus, the pressure in the stomach and duodenum is suddenly removed, and the bile in the gall-bladder and ducts being still compressed, moves the calculus towards the part where pressure has for a moment been diminished.

In a case of chronic gall-stone disease, which came under my care, every attack of colic was accompanied by vomiting, and subsequent jaundice. Here much importance might have been attributed to the effect of vomiting in the expulsion of calculi, which subsequently actually took place. On a post-mortem examination it was however found that the calculi had passed through a fistulous communication of the bladder with the duodenum, and that many calculi did yet remain in the bladder. Here the vomiting was evidently symptomatic of the lesion of the duodenum, as in other cases it is symptomatic of the pressure of a gall-stone upon the duodenum or even upon the pylorus.

In a few cases, where the stomach has evidently or avowedly been overloaded, or where the filled condition of the stomach threatens convulsive symptoms, an emetic of a scruple of sulphate of zinc or of ipecacuanha, the latter joined perhaps with a few grains of potassio-tartrate of antimony, may be advisable or even necessary.

Stokes, in the fourteenth of his Lectures, "On the Theory and Practice of Medicine," reported in the 'London Medical and Surgical Journal,' 1834, v, 263, admits emetics only in the early stage of the disease, and where there is no distension of the gall-bladder. As a salutary warning against these remedies he adds the following case of rupture of the gall-bladder, caused by the effect of emetics: "A distinguished medical friend of mine has related the particulars of a case in which the exhibition of an emetic was followed by rupture of the gall-bladder and fatal peritonitis. In this instance the case was not so deplorable, so far as the patient was concerned; he was labouring under extensive disease of the liver, and only exchanged a lingering for a sudden death; but this furnishes no excuse for a medical practitioner." Similar cases, and cases of inflammation of the biliary ducts, have been observed by many physicians, and among them Morgagni; Portal and Pujol have therefore enjoined the greatest caution in the use of emetics. This caution is very reasonable, and should be respected as an absolute injunction to abstain from the use of emetics in all cases where the gall-bladder is enlarged owing to obstruction of the common duct.

Warm poultices to the painful region make perhaps more impression upon the patient's imagination than upon his pains, but they cannot be neglected nevertheless, particularly in cases where other means for the relief of pain are not immediately at hand, or tardy in their action. Half a dozen hot dinner-plates, wrapped in a flannel or piece of blanket, are the best condensers of heat that can be applied, provided the pressure can be borne. If the patient cannot endure it, a bottle with hot water may be placed by his side. Of these commodities it is well to prepare a supply, as they are very effectual in stopping or preventing rigors and shivering, and ultimately inducing relaxation of the fibres and tissues of the body by the warmth and gentle perspiration of the surface and extremities to which they are applied. With a similar object warm water baths have been recommended, and Stokes (loc. cit., p. 263), says that signal advantages accrue from the use of the warm hip-bath in gall-stone colic. He had seen cases in which the most extraordinary relief was obtained by applying twelve leeches over the region of the gall-bladder, and then placing the patient in a hip-bath. The best effect would no doubt be obtained by bringing the patient into a hot-air bath, and keeping him there in a gentle temperature (100 to 115° F.) while applying all necessary drugs and proceedings. Many patients who cannot lie still, and cannot bear any bed-clothes upon their bodies, would be very comfortable in a Turkish bath. But where such a rare commodity cannot be had, and a water bath is not feasible, a warm room, warm bed covering, and small doses of stimulants, such as claret or port wine mixed with hot water or hot tea and sugar, and drank as hot as possible, are also very effectual in removing coldness, suppression of the pulse, and tendency to fainting, and restoring a genial temperature of the body.

Many learned and experienced physicians have recommended that some blood should be drawn from patients suffering of gall-stone colic, either from the arm by venesection, or from the region of the liver, by leeches and cupping, or from other parts by the same agencies. Among the older cases which I have studied, there are a good many which contain unmistakeable evidence that the patients died of the oft-repeated abstraction of blood. There are not any cases on record in which the abstraction of blood could be said to have had such an objectively observable effect as could be considered an equivalent for the trouble and loss of strength inflicted upon the patient. In consequence of this experience and of the relinquishing of bleeding generally in the practice of physic, the great number of patients with gall-stone colic are not bled any longer; some, however, are still subjected to a moderate loss of blood, on grounds which vary with the practitioners.

Stokes (l. c., p. 261) recommends bleeding, to prevent the assumed liability to inflammation of the biliary passages through which a gall-stone is passing; for the same purpose, he in severe cases applies leeches as well. These, he remarks, allayed spasms, and favoured the passage of the calculus. He next gives purgatives and enemata, and ultimately opium in full doses. He insists upon the application of these remedies in the succession in which they are here given. Frerichs, the latest writer on this subject, who formularises less and yet is not so diffuse as French authors on this subject, says that in full-blooded patients, with great excitement of the heart's action, congestion to the head and similar symptoms, venesection has to precede the application of sedatives. He continues by averring that in many cases general abstraction of blood suffices to overcome the spasmodic grasping of the concretion by the gall-duct; he guards his readers, however, against using venesection indiscriminately in all cases of this disease. As a special indication for local abstraction of blood by cupping or leeches, he considers great tenderness in the region of the gall-bladder or even the entire liver.

Against the practice here recommended it may be urged, that the same learned and experienced physicians at one time recommended and practised bleeding, leeching, and cupping in diseases, such as pneumonia or hæmoptysis from tubercles, in which they themselves, as well as their younger contemporaries, do not employ these proceedings any longer, and that no special grounds have been adduced since this change, why the old practice should be retained for gall-stone colic. Indeed, I have never had any case under my care, nor have I ever had to deal with any attack in any of the chronic cases which have been under my care for years, in which any abstraction of blood appeared to be desirable or necessary. To allay the spasmodic grasping by the biliary duct of the calculus, does not appear to favour the expulsion of the calculus, which can only be effected by peristaltic action of that duct, and does therefore not appear to be a desirable result. It is however desirable that this contraction of the duct (and who would venture to diagnose between a spasmodic grasping of a tonic and one of a clonic or peristaltic nature! or who would assert that a tetanic grasping of the calculus by the duct, without any propulsive muscular contractions, does exist!) should take place, but at the same time it should be accompanied by the least possible pain. In gall-stone colic we have therefore the same indications as in parturition with excessive pain, namely, to mitigate the pain, without stopping the expulsive contractions. Where pain and contraction are stopped at the same time, the gall-stone has a tendency to become fixed, and cause chronic jaundice and a train of other symptoms. The abandonment of bleeding, and the greater variety of anodynes, appear to be some of the principal reasons why gall-stone disease causes jaundice in a smaller number of cases than it appears to have done formerly, when it was considered necessary to entail this conspicuous symptom.

As gall-stones, after repeated attacks of colic, relapse into the gall-bladder or remain fixed in some part of the biliary passages, and as gall-stones were sometimes found in the gall-bladders of living persons, who had passed one or more of these concretions, or never suffered any symptoms of colic from them, physicians became naturally anxious to discover some remedy by which these concretions in the biliary channels might be chemically dissolved. This desire caused Durande to make some experiments with a mixture of ether and turpentine, which had just been discovered to dissolve and disintegrate cholesterine calculi.

Durande benefited his patients, apparently, and as he believed, by dissolving the gall-stones which were supposed to exist in their biliary passages, and which were not searched for in the fæces. However, Thenard already showed that this hypothetical solution of concretions in the living body was impossible, and that the effect of the remedy must be ascribed to the anæsthetic and anti-spasmodic effect of the ether. I have used the mixture of Durande in some instances, and always had some difficulty to prevent the patients from continuing it for an undue length of time. For I had found, what I remember to have seen recorded as the result of the experience of others, that when the mixture is used improperly, or too long, or even according to rule, it is apt to cause inflammation. In one of my cases, where it was taken for years, the chronic inflammation of the liver and neighbourhood of the gall-bladder appeared to me to have been produced, or at least greatly aggravated, by this mixture, or by the turpentine which it contains. By its diuretic action the oil of turpentine may sometimes usefully influence the kidneys in cases where the epithelium is impregnated with yellow colouring matter, and consequently somewhat impaired in action. But this must be so rarely the case, that the consideration of this effect is almost superfluous.

Frerichs, based upon the appearance of erosion observed upon certain gall-stones (which erosion was already observed by Haller, and ascribed by him to the gnawing of invisible animalcules), has pronounced his belief that gall-stones may be dissolved. He says that the conditions under which a solution of the calculus is brought about vary according to the nature of the external crust, and, let us add, according to the nature of the fluid, that is to say bile, which is to effect the solution. He assumes that very alkaline bile could dissolve the cholesterine, the compound of cholepyrrhine and lime, and the cholate of lime and mucus of a mixed calculus. Of this occurrence the corrosion found upon a few calculi (which we have also observed in a few instances) seems very slender evidence. That the alkaline bile will not produce any change upon a crust composed of carbonate of lime, may be admitted, and it may be gratefully remembered that such crusts are happily rare among gall-stones. But that this watery bile may loosen the stones, dissolve their connective material, and so lead to their mechanical destruction or comminution, appears not to be supported by any evidence whatsoever. A mechanical comminution of a calculus could be effected by strong contractions of the bile-duct, or of the intestine, or of the sphincter ani, particularly if it had been previously softened by a suitable kind of bile. But how a thin bile simply is to effect this, remains to be shown.

As we can effect the secretion of a somewhat alkaline bile without interfering with the function of the liver or the efficiency of the bile, it is reasonable to make further inquiries and experiments in this direction. Bile contains phosphate of soda, and its quantity can be increased to some extent by supplying this salt in larger quantities to the blood. Phosphate of soda recommends itself, therefore, not only as a purgative by itself, but also as an addition to other saline purgatives, and as a direct remedy for increasing the alkalinity of the bile, and of its hypothetical action upon biliary calculi.

But though the corrosion of calculi might be due to the alkalinity of the bile, the expulsion of entire calculi as a consequence of the use of alkaline mineral waters requires a different explanation. It has accordingly been assumed that the process here indicated is caused by an increased flow of bile. There can be little doubt, from experiments made upon dogs with biliary fistulæ, that the drinking of large quantities of water increases the amount of water in the bile, though perhaps not its other ingredients. But whether this slight increase would at any time produce such a current as to carry calculi before it, seems very doubtful. The effect of mineral waters, particularly the saline and alkaline ones, is certainly more complicated, and much value has to be ascribed to their purgative action, and the general revival of all the abdominal functions by a free and accelerated circulation. However that may be, practically there is no doubt, that many cases of gall-stone disease have got well under the use of the mineral waters of Karlsbad, Eger, Marienbad, Ems, Vichy, and even of Pyrmont and other chalybeates. In many severe cases Frerichs directed his patients to go to Karlsbad, and has known them to return cured. A very striking instance of the efficacy of Karlsbad in a severe case of gall-stone disease will be found in the 'Clinical Record.' The Vienna physicians also send their patients to Karlsbad, and many, Skoda and Oppolzer among them, have recorded striking results from the use of the spa. When patients were prevented from going to the Bohemian town, Frerichs ordered them to get the waters of the millspring of Karlsbad sent to their place of residence, and to drink it there under the ordinary precautions, either cold or warm. The experience and writings of the French physicians, among them Fauconneau-Dufresne and M. Petit, are similarly in favour of Vichy water, though among the cases which I have read in various works, there are many, which, although they parted with one or more calculi, nevertheless remained under treatment when their history was printed.

In cases where the gall-bladder is enlarged and distended with bile, these mineral waters must be used very cautiously, as they easily make matters worse. In cases, on the other hand, where the obstruction to the bile is only partial, and in all cases where there is none, they may be used freely. In French records we find cases where 25, 27, 30 half-pint glasses of Vichy water were drank per day, in some ineffectually at first, but with a satisfactory result at a later period. In some cases the calculi were expelled and the patient cured after seven summer courses of mineral water drank on the spot. Disappointment need, therefore, not cause despair, but whenever it is possible, the efforts to cure the evil by these agents of nature should be persisted in for a series of years.

The properties and effects of the several spas are so modified as to be specially adapted to special collateral conditions of gall-stone disease. In cases with obstinate constipation Vichy is specially indicated; for cases of irritable and debilitated persons with a tendency to diarrhœa, Ems should be recommended; plethoric and apoplectic people had best go to Marienbad and get rid of their superfluous material. The saline, purgative, and chalybeate tonic waters, such as Friedrichshall, Saidschütz, Püllna, Homburg, and a great many others, may be useful under certain circumstances. In some cases of chronic gall-stone disease, one with a calculus fixed in the common duct, which caused a partial retention of bile and jaundice, the use of Püllna water had a beneficial effect, by raising the strength of the patient and causing an increase in the quantity of urine.

In many cases in which we may be under the necessity of prescribing remedies of a less costly nature than those just mentioned, salts compounded in imitation of the substances contained in these mineral waters may be dissolved in either cold or hot water, and used by the patient.

Hoffmann first employed alkalies in the treatment of gall-stone disease, for the purpose of dissolving the concretions. Bianchi and van Swieten imitated his practice, but acknowledged it to be a failure. Nevertheless, alkalies are frequently given, even in the present time, and their use has derived support from the effects of the alkaline mineral waters. Bicarbonate of soda by itself, or in combination with sulphate of soda, is given by some. The common carbonate of soda has also been employed; Frerichs remarks that the bicarbonate should be dissolved in large quantities of water, as in a concentrated form it was apt to derange the digestion. When given in a concentrated form, rhubarb, aloes, and other purgative tonics should be added. The alkaline salts of vegetable acids, such as the acetates, citrates, and others, have been recommended by Bouchardat as substitutes for the carbonate, without offering any special advantages.

The treatment of jaundice requires some special remedies of an alterative or specific nature. A medical gentleman found great benefit to accrue from the use of dilute nitric acid. I have employed a solution of nitrous acid (prepared by distilling nitric acid over starch, and to be had of

Messrs. Bell and Co.) in doses of a drachm and upwards, diluted in the proper manner, and found it of service. The spirit. nitr. dulc. may be used for the same object, as it always contains nitrous acid. The nitrous acid appeared to liberate the cells of the epithelium of the kidneys of the cholochrome deposited within them, and thereby to admit of a better depuration of the blood. It also exercised a tonic effect upon the stomach, and rectified chronic indigestion. But of the action of this medium further experience is required before its use can be finally determined.

In most cases of chronic jaundice purging is required for the maintenance of the general health, and I have known a case to get well repeatedly after some continued spontaneous purging. This object can be attained also by such an agreeable process as the grape-cure. Van Swieten recommended a decoction of grass and other herbs as a cure for jaundice, and several curious instances of the success attending this mode of treatment are recorded. Among others, is the case of a poor man, who for two years lived by his directions almost wholly upon grass, taking it boiled in broth as his ordinary food, and drinking the decoction sweetened with honey. The patient was not only completely cured of his malady, but became so great a connoisseur in this novel diet, that he could tell which were the richest pastures by the taste of the grass. Moreover, he consumed such quantities that the farmers drove him from their fields by force, so that, in addition to his other calamities, he was compelled to obtain it by stealth. ('Catalogue of the Calculi contained in the Museum of the Royal College of Surgeons,' p. 161.)

In years gone by it was a common practice to treat gallstone patients with mercury, until they were in a state of salivation. This practice has happily become very rare now, but is by no means obsolete. A short time ago a patient came under my care, who had been twice salivated, by two of the first physicians of Dublin, for jaundice from obstruction of the common duct by a calculus. She had been weakened very much thereby, but the disorder had not been changed. There is no sense in giving calomel and opium in such a case, or in any other case of jaundice from whatever cause, syphilis excepted. Calomel is not a cholagogue, but diminishes the secretion of bile; it does not affect the concretion, or the consequences of the jaundice upon the tissues, but superadds its own cachexia to that produced by the obstruction of the liver.

ILLUSTRATIVE CASES.

CASE 1.—*Chronic gall-stone disease, terminating fatally by inflammation of the liver.*

The following case, which I had an opportunity of treating for several years, and watching to its conclusion, shows that gall-stones may exist in the gall-bladder during forty years, cause many attacks of colic, and yet permit the patient, with prudent living and medical assistance, to attain a very high age.

In the year 1853, I was requested to attend a gentleman, aged seventy-five, who, after having enjoyed excellent health for many years, was suddenly taken ill with the usual symptoms of the passage of gall-stones. On being questioned, he remembered having passed a gall-stone thirty-five years ago, which had been found in the evacuations. Some slighter symptoms made a continuance of other concretions in the gall-bladder, during the whole time which had elapsed since that occurrence, very probable. With the use of opium and occasional large draughts of warm water when the sickness was greatest, he recovered from that attack. After the passage of some gall-stones the strongly-marked jaundice disappeared.

In the following year, he had another and more severe attack. It is probable that in this attack the false passage was formed from the gall-bladder to the duodenum, which I found at the post-mortem examination, and the cystic termination of which inclosed an impacted calculus. The attack terminated with the discharge of gall-stones, brown biliary matter, and subsequent bilious diarrhœa.

From that time he began to take the mixture of turpentine and ether, and with so much apparent benefit, that during the subsequent four years the old gentleman allowed few days to pass without taking from half a drachm to a drachm of the mixture.

At the beginning of the winter of 1857 to 1858, his general health began to fail. A settled pain in the region of the gall-bladder indicated chronic inflammation there. Notwithstanding all suitable treatment, he sank and died, very nearly eighty years old.

The post-mortem examination revealed a gall-bladder full of calculi as the primary disease. Exudative plastic inflammation pervaded all neighbouring tissues.

The gall-stones were pulpy outside, and seemed to be made up of soft, brown, colouring matters; in the centre they were made up of crystallized cholesterine. The bladder contained one hard stone inclosed in a false passage leading towards the duodenum. The cells of the liver, when inspected under the microscope, contained yellowish-brown colouring matter in granules.

Case 2.—*Jaundice from partial occlusion of the common duct; evil effects of mercurial treatment remedied by the Turkish bath.*

A lady, aged forty-four, came under my care in the course of last autumn. At the age of eight she had been jaundiced, but quite recovered her health. She married, and had seven children. During the last eight or ten years she had occasionally been troubled with digestive derangement, spasm after food, and collateral symptoms, which were removed by hot water drinks, opium, and other means. Nearly two years ago, after a dinner-party, she had a sudden attack of pain round both hypochondriac regions. Four days after this attack, the conjunctivæ were observed to be yellow, and some days later the white fæces, and the coloured skin and urine, revealed complete obstruction of the bile. Her medical attendant prescribed mercurials, which she took until her gums were sore, and remained so for six weeks. As she was not benefited, but on the contrary much reduced, she went to Dublin, and was treated homœopathically, but with no better success. She then went under the care of a celebrated physician of that town, and was again mercurialized to salivation. Her strength now failed completely, while the disease had not abated. She thereupon began to use the Turkish bath, and soon found her strength return, and her energies renewed, although the jaundice persisted. After a course of baths extending over six weeks, she returned home, and had the satisfaction of seeing the jaundice clear off without suffering or treatment.

After a tour on the lakes of Killarney the jaundice reappeared, whereupon she took a second course of hot-air baths. They had apparently no direct effect upon the jaundice, but appeared to keep the bowels perpetually relaxed. After returning home, she got quite well a second time.

But a few weeks later she became jaundiced a third time, in consequence, apparently, of exposure to night air. A course of Turkish baths taken during the summer was not followed by any apparent benefit.

When I saw her, her general health was good ; the jaundice continued, though the fæces were coloured almost normally. There was no tangible enlargement of the liver.

I prescribed a course of Püllna-water, which benefited the general health, and produced a more copious flow of the urine. Next spring she will probably use the waters of Vichy or of Karlsbad.

CASE 3.—*Many small angular gall-stones gradually pass through the ducts, and are evacuated; complete recovery.* (Communicated by G. Tate, Esq.)

The Rev. S.C—, aged forty-five, a free liver, corpulent, and given to the pleasures of the chase and similar pursuits, was generally in the enjoyment of good health, excepting that he suffered from occasional attacks of gout, which was hereditary in his family. He was one day seized suddenly, and without previous indisposition, with violent pain in the epigastric region, vomiting, &c., which, after enduring some hours, left him. On the following day he was jaundiced. His urine was loaded with biliary colouring matter, and his stools were colourless, and there could be no doubt that he was suffering from gall-stones. The evacuations were carefully washed, and a small angular gall-stone (weighing only a few grains) was detected. It had so many polished sides, cut clean like the work of a lapidary, that it became certain it formed part of a mass of small stones. From the time of the first attack till about four or five weeks afterwards, the patient passed at intervals between 110 and 120 of these small biliary calculi, after which he got quite well. Sometimes two or three would pass at one stool, the pain and sickness always corresponding in more or less severity with the magnitude of the stone, so that in the course of a little time the patient could, from the greater or less acuteness of the pain, foretell and determine the size, and almost the shape of the calculus that was passing the ducts, sometimes with so much precision as to prognosticate sharp angles, or the reverse, on the stone to be obtained from the stools. The size of the calculi varied from that of a mustard seed up to a peppercorn; but they were all angular and flat-sided, some having three, and others four or five sides, like bits of mosaic.

CASE 4.—*An extremely fat woman is reduced to excessive leanness by the sufferings caused by a gall-stone, but recovers her obesity after having parted with the concretion.* (Communicated by G. Tate, Esq.)

Mrs. R—, aged about sixty-seven, a rough farmer's wife, mother of a large family, excessively corpulent (so much so, that in addition to her general obesity a large number of fatty tumours were deposited upon her arms, legs, and body), was attacked with urgent symptoms of gall-stones, followed by jaundice. After the first attack there was an interval of rest for a few days, and then a recurrence of the same symptoms as before, in an aggravated form. They continued to return at intervals of a few days, the pains being tremendous, for many weeks, the jaundiced skin remaining all the time, sometimes of a deep yellow, and at last of an orange-green colour. The alvine evacuations were almost always white as chalk, but no gall-stone could be found in them. Her body, from being loaded with fat was reduced in about seven weeks to a mere shadow, all the fatty deposits disappearing. About two months after the first seizure, and when worn down with the great suffering and prostration of strength, she had occasion to go to the night-chair, and heard a hard substance fall into the pan. Being a woman as grossly ignorant, and surrounded by others equally so, in mind, as she had been grossly fat and vulgar in person, instead of preserving the stone until Mr. Tate's next visit (as she had been instructed to do in case of its expulsion), she or her attendants took the stone from the pan, and in their curiosity "to see what it was made of," broke it to pieces with a hammer. They did not even preserve the fragments, so that it was impossible to ascertain weight, bulk, or other characters of the calculus. From the long duration of the case, the urgency of the symptoms, and from the sound given out when falling into the pan, it must have been of large size, and from the description of it by these stupid people it was about two thirds of an inch in diameter, being an oblong spheroid. From the time of passing the stone the woman rapidly recovered, and in the course of a few months was as bulky as before the first attack, even the fatty tumours having made their reappearance.

CASE 5.—*Gall-stone colic; jaundice; discharge of gall-stones; recovery. Described by the patient in a letter to the author.* (December 2nd, 1859.)

"I have just read in the 'British Medical Journal' your paper on the pathology of gall-stones, and having myself suffered very severely from this complaint, the subject is one naturally of great personal interest to me. I think it is not improbable that, in my case, the cause may be attributed to great mental and bodily strain during the prevalence of cholera in 1854. I was quite prostrated at the time, and have certainly never been well since. In the spring of this year I had a severe attack of illness, which I at once attributed to gall-stones, but my medical friends thought it was subacute inflammation of the liver, for which I took calomel and opium with salines. I was jaundiced, and the spasmodic pain was most intense, and lasted from four to six hours. The intervals between the paroxysms gradually diminished, and in parts of May and June there was a daily recurrence. All speculation in the matter was set at rest in the latter month by the detection of gall-stones in the fæces. The last severe attack was on the 24th June. But I have been and am frequently subject to much uneasiness in the region of the gall-bladder, without tenderness on pressure, and am constantly apprehensive of another attack; indeed, within the last twenty-four hours, I feel that one is now threatening. I have flatulence, distension, pulse 60, with anomalous pains in the stomach, gall-bladder, and back, and pink deposit in the urine. There is at present sufficient biliary colouring matter in the fæces. My age is fifty. During the paroxysms I took large doses of Battley's sedative tincture of opium, hot fomentations, mustard plaisters, blisters, &c., without much relief. In the last attack I took chlorodyne, and think with much benefit; at all events the pain was of much shorter duration. During the attacks sickness of a very acid nature was incessant."

Two months afterwards, in the course of a letter upon another matter, the patient informed me "that he was better," and attributed his improvement "to the change procured by a visit to Brighton and the internal use of diluted nitric acid and gentian." How far the infusion of gentian root can influence either gall-stones or jaundice, I am not in a position to surmise. But that diluted nitric acid has a considerable influence over the residues of jaundice in various tissues, particularly the epithelium of the tubules of the kidneys, seems a sufficient explanation of the improvement obtained in the above case. It must, however, be borne in mind, that the treatment, however beneficial to the individual, only affected collateral indications, and had no bearing either upon the decomposition of bile in the biliary channels, if it continued, or upon the biliary concretions themselves, if any did yet remain in the gall-bladder.

Case 6.—*A large gall-stone passed without jaundice, but with considerable hæmorrhage.* ('The Lancet,' March 12th, 1853, p. 254.)

Medical Society of London.—Mr. Childs exhibited a large biliary concretion, with the following account of the case:—Mrs. W—, aged thirty-six, a person of bilious temperament, in July, 1850, about a fortnight after her confinement, was seized with a severe pain in the right side. This was combated with castor oil and other aperients, taken consecutively for about twelve or fourteen hours, without the desired effect. A blister was subsequently applied over the region of the liver, which relieved the pain, but left a feeling of fulness and obstruction about that region. In about a week a painful tumefaction appeared below the ribs of the right side, for which leeches and poultices were applied, with the effect of removing the swelling, but the pain remained, which now extended to the right shoulder, and became much aggravated by inattention to diet or bodily exertion. In the spring of the subsequent year she was frequently seized with fits of shivering, and, to use her own expression, "her side felt as if it would burst, and as if it were drawn up into a knot." In the latter part of last year these symptoms had considerably increased, and on the morning of the 25th of December she was seized with a violent pain in the bowels, attended with vomiting, which continued for four-and-twenty hours. The pain in the side continued, and from a dull aching became sharp and lancinating. About 6 p. m., having a call to evacuate the bowels, the concretion passed, accompanied with considerable hæmorrhage. I learn that during no period of her illness had she been jaundiced, nor was there any difficulty in managing the state of her bowels, the evacuations being of a natural colour and consistence.

CASE 7.—*Effect of cod-liver oil in gall-stone disease.* (Statement of Dr. Williams in the course of a discussion at the Royal Medical and Chirurgical Society, May 9th, 1848.)

Dr. Williams related the case of a gentleman who suffered from all the symptoms of the passage of gall-stones, distinctly marked, not only by pain and jaundice and obstructed flow of the bile, but also by a tumour corresponding to the position of the gall-bladder. This tumour presented itself before each attack; on percussion around it, a tympanitic sound was detected. The patient's health declined. He was of sedentary habits, and the attacks became so frequent that they occurred every ten or fourteen days. No medicine or diet that he was placed under seemed to be of any particular service to him, and his friends and attendants began to suspect, notwithstanding the clearness of the signs, that his complaint was not, in reality, found out. The fæces, on being examined, were found to contain concretions, consisting of cholesterine. What, then, could be administered to prevent the formation of these fatty concretions? It was determined to try the effect of the cod-liver oil. After a very short time the bile was found to be better secreted, both in regard to its quality and quantity. No attack of gall-stones occurred until the end of three weeks. On examining the abdomen the same lump was found as before, but two inches lower down in the abdomen; and the liver, which before could not be felt at all, was now to be detected by the touch, two inches below the margin of the rib; it was evidently enlarged, but neither painful nor tender. This attack went off under the use of the usual remedies, and in a few days the cod-liver oil was resumed, and up to the present moment, a period of two months, there had been no return of his attack. His digestion was better, and his health much improved. This was a solitary case, but it was interesting taken in connection with the increase of the size of the liver and with the improvement of the patient's health. It showed that the cod-liver oil, in opposition to remedies of this class generally, promoted the proper action of the liver, and consequently the secretion of bile.

CASE 8.—*Thirty-six calculi passed by a person aged eighty-three.* 'Transactions of the Reading Pathological Society;' Annual Retrospective Address, by Nathaniel Crisp, Esq., July 18th, 1860); ('British Medical Journal,' November 24th, 1860, p. 920.

Mr. Breach exhibited thirty-six biliary calculi, passed by a female eighty-three years of age, after slight pain and sickness; the largest of them weighed four drachms two scruples. Constipation had previously existed for a week, and was then followed by diarrhœa.

CASE 9.—*Effect of Carlsbad water in gall-stone disease.*

Dr. H. Smith, of New York, relates the following case:—"A near connection of my own, accustomed from his eighteenth year to consume, on an average, a pound of confectionery per day, became afflicted with such an accumulation of gall-stones that, by relaxing the abdominal walls, they could be very distinctly felt, forming an irregular tumour of the size of the closed fist, in the situation of the gall-bladder. The engorgement of the liver became so great that its lower border reached two and a half inches beyond the navel, measuring towards the left groin, and four inches below the edge of the ribs, measuring directly downwards. Violent attacks occurred at shortening intervals; at length so frequently, that the jaundice attendant on the one attack had not time to subside before the next occurred, so that at last his colour became of a dark, dirty green. In the spring of 1841 I sent him to Carlsbad. He nearly died of an attack in London, on his road to the springs; was pronounced moribund by three of the ablest physicians of that city. However, he contrived to reach his journey's end, and after a few days' use of the water passed an incredible number of gall-stones; the tumefied liver shrank to its normal dimensions, and he returned home a new man. He remained without any relapse until the second spring, when the threatening symptoms induced him to return for a short season to Carlsbad. Perfect relief was again obtained, though no more calculi were observed to pass. The next year he spent ten days at the spring by way of clenching the nail, and he continued free of colic until his death, in the fall of 1847. This event was preceded by a new series of symptoms, pointing to deep-seated disorganizing disease of the liver, permanent jaundice, dyspepsia, then perfect anorexia, ascites, great prostration. The liver was found cirrhotic and studded with deposits of cholesterine, many of the size of a nut; the gall-bladder empty, and the duct enormously dilated."—*American Medical Times.*

Case 10.—*Gall-stone colic, jaundice, and expulsion of calculi.* (Coe, l. c., p. 46.)

"One of the first remarkable cases of gall-stones which fell under my observation many years ago was called by the person who had the care of the patient before me an odd kind of colic. And, indeed, there appeared to me something uncommon. Therefore, as the case was perplexed, and as jaundice had not yet appeared, I am not ashamed to say that I sat by the patient a whole hour, observing, examining, considering, and comparing the seat and manner of the complaints with all the other circumstances of the case. At length I declared my opinion to be that neither the stomach nor the guts were the parts primarily affected, but that obstructions in the biliary ducts were the cause of this colic, and that probably we should soon see a jaundice come on, which would give further light into the case. My opinion was not assented to at first. However, I said I had formed it upon mature consideration, and I would not depart from it unless I saw reason to alter my mind. Within four days the jaundice appeared, which gained some credit to my opinion, and within four more the obstructing bodies were found in the stools, and the patient very soon grew well. I had committed the search to a very careful person; otherwise the calculi, which were small, had been thrown away undiscovered, and the patient got well, though it had not been known how, as often happens in this case for want of a proper examination of the stools."

To this case Coe adds a useful caution in a note to the following effect:—When solid bodies are found in the stools of these patients they should be preserved for the inspection and examination of proper judges, and not concluded to be gall-stones from the report of ignorant people, who, if they find anything particular among the fæces, are apt presently to imagine it to be what they were ordered to search for. He had heard of cardamom seeds, of the seeds of oranges, of pills voided whole as they were taken, and the like having been taken for gall-stones. He also relates the case of a man suspected of harbouring gall-stones, in whose fæces a calculus was found, which, supposed to be biliary, turned out to be a pebble, sometimes contained in and eaten with dried currants.

CASE 11.—*Treatment of gall-stone colic towards the end of last century.*

The following case is quoted to illustrate the kind of treatment which was in frequent use in the past and the beginning of the present century. It shows how unnecessary bleeding is in gall-stone disease, and how dangerous it may become if combined with the administration of opiates.

G. C. Conradi, 'History of a Gall-stone' (Hufeland's, 6, 474, 1798).—"The wife of a general, between fifty and sixty years of age, of a robust and well-nourished body, and of healthy red appearance, had suffered at intervals during ten years of very severe spasms in her stomach. During the free intervals, which lasted several months or quarters of a year, she had enjoyed good health.

"On the 7th October, 1794, in the morning, at three o'clock, I was called to her, as she was suffering of the most severe spasm of the stomach, which had persisted during three days, defied many remedies, and reached its highest point in this night. The patient complained of the most severe pains in the somewhat hardened gastric region, which increased by external pressure with the hand, and continued into the lower part of the abdomen. She was constantly sick, and vomited everything she took immediately, moaned incessantly, and prayed for relief. The pulse was fast, small, but hard; the bowels were confined. The medical attendant, a regimental surgeon, who had treated her during upwards of twenty years, and had already frequently assisted her in similar attacks, had, during the last three days, used gentle emetics, laxatives, clysters, internal and external remedies of an antispasmodic nature, including laudanum, but all had been in vain.

"External emollient cataplasms, inunctions, dry cupping on the region of the stomach, laudanum in doses of twenty drops, which, as well as a mixture of Ol. Amygd. dulc. ℥ij, Syr. Diacod. ℥j, Aq. Menth. ℥vj, a teaspoonful taken every half hour, was rejected by vomiting, produced neither relief nor motion of the bowels. At daybreak I took sixteen ounces of blood from the arm of the patient, in order to prevent inflammation, or to relieve that which, in all probability, did already exist. My colleague saw the blood which had been taken, was very well satisfied, and prognosticated a speedy improvement. The patient then sat for an hour in a lukewarm hip-bath, and after this had a clyster of chamomiles with thirty drops of laudanum applied. Upon this, to the pleasure of all, ensued complete intermission of the spasms, a general perspiration, and a natural sleep of two hours.

"On the morning of the 18th of October.—The last night has been good, and now the patient does not complain any longer about pain, but only about an indistinct sensation in the abdomen. The spasm of the stomach has ceased entirely, but the fever is rather violent. Since yesterday two feculent stools have been passed. The above mixture was continued, with this change, that Aq. fontan. was substituted for Menth., and Sal. essent. Tartari ʒj was added.

"In the afternoon the fever became very violent, the heat was very great, the face flushed, the breath quick, with continued moaning; the pulse quick, small, but hard, like a wire; and, what caused us the greatest uneasiness, the patient was lying quite without consciousness, in a sopor, somnolent. Sal essent. tartari, with nitre and sugar; clysters. According to all indications derived from the bodily condition, the disease, and the symptoms, I thought again a small venesection necessary; but my colleague would not by any means consent, and made me the hurting reproach—that this violent soporous fever proceeded from yesterday's venesection, because it had been too strong.

"On the 9th of October.—Throughout the night the soporous fever had continued without interruption until towards morning, when, with some return of consciousness, it abated; the tongue was smeary and dry, the skin moist; the bowels had been moved; the patient did not complain about anything. In the afternoon the fever, with the comatose slumber, increased again; there were also again vomiturítions after the medicine or drink, for which reason Potio Riveri was used. To-day three fluid stools.

"On the 10th of October.—Has slept through the whole of last night rather firmly, and also to-day through the entire day; fever yet very violent. I put Spanish flies (cantharides) upon the back of the neck and upon the calves, and added the pulp of tamarinds to the last medicine.

"On the 11th of October the violent fever and the sopor abated; consciousness had completely returned; in the abdomen was a dull pain; the plaster had drawn strongly; the skin was moist; the urine dark red, with much deposit, like brick-dust. Pulp. Tamarind., Extr. Gramin., Tart. Tartarisat.

"After this, repeated thin, bloody stools were passed; there were no very great pains, no great weakness, only slight fever. Pulse still irritated, hardish, spasmodic. A third very eminent physician, who saw the case accidentally, thought a venesection not unserviceable, which was, however, omitted, because it was not thought very necessary. This judgment was very satisfactory to me, on account of the above unmerited reproach.

"This condition, with the bloody stools, lasted up to the 18th. From that day to the 27th the patient was without particular incidents, but could not properly recover; there was reason to fear that the enemy was still present in the abdomen.

"On the 27th of October the pains in the abdomen began again very violently, and lasted until the 28th, and during this time a mixture of Ol. Amygdal. dulc., Syr. Diacod., and Opium, inunctions, &c., were tried in vain. At last, in the night before the 29th, I ordered a clyster with forty drops of laudanum. At twelve o'clock the colic was over.

"On the 29th of October.—Gentle perspiration; towards morning a gall-stone, of the size of a walnut, round, without sharp corners, light, of a variegated colour, had been passed in the stool; the urine was brown, like weak coffee. The patient was now, with the exception of some weakness, very well, and was very glad to have got rid of her evil enemy.

"On the morning of the 30th I saw the lady as yellow as a guinea; she suffered, however, no further, and under the use of antispasmodic and resolvent remedies she got perfectly well in a few days. Since that time she has, for three and a half years, remained without any symptom that could indicate the presence of other gall-stones, although she has made several journeys and suffered frequent care and anxiety, such as this war causes to many a mother.

"This gall-stone, therefore, caused spasms of the stomach-colics, a soporous fever, the so-called flux of the liver, and, lastly, jaundice. Why did the latter only show itself after the calculus had been passed, and the biliary passages had consequently been opened again? Perhaps because the spasm in the biliary system ceased, and consequently the bile, which during the spasm had been shut up, could pass into the juices by the absorbents without hindrance. Without any doubt, the calculus passed only during the repeated and last spasmodic act, on the 28th of October, from the ductus choledochus into the intestines; it is, therefore, surprising that after the 8th of October it did not cause any more liver-colics. The bloody stools, which frequently resembled the washings of flesh, proceeded, no doubt, from the tearing of some blood-vessels in the biliary passages while the large calculus passed these narrow canals. These same bloody stools, which lasted from the 11th to the 18th, served, no doubt, instead of beneficial venesections against the inflammation, and could be all the more beneficial because the blood proceeded from the suffering parts themselves. What may be the reason that this calculus did not pass already during the former attacks of spasms of the liver and stomach, of which the patient suffered periodically during at least ten years, considering that the calculus was then certainly much smaller? Probably because the gall-bladder can exercise a greater contractile and expulsive power upon a large than upon a small calculus. During the whole time, from the 7th to the 28th of October, during which the calculus obstructed the biliary passages, the patient, strangely enough, passed, not whitish-gray, but ordinary coloured stools. My rather strong venesection saved the very eminent, robust, plethoric, and well-nourished lady from inflammation and mortification of the intestines; however, if she had died during the very violent soporous fever, the good-natured public would, no doubt, have believed that I had killed her by it."

12. *A discussion on the treatment of jaundice and gall-stones.*—I subjoin the account of a curious discussion which occurred just twenty-four years ago. It is contained in 'The Lancet' of November 10th, 1838, p. 274.

MEDICAL SOCIETY OF LONDON.

Monday, October 29th, 1838.

MR. BRYANT, President.

Jaundice, and obstructions to the flow of Bile.—The treatment of Liver disease.—The advantages and dangers of Mercury and Alkalies.—Value of Antispasmodics.—Necessity of studying the remote causes of disease.—Magendie's Lectures on the Blood.

The discussion of this evening arose out of a question asked by Mr. Crisp, at the last meeting, respecting the effect of a sea-voyage on an obstinate case of jaundice, in which he considered that no mechanical obstruction existed.

Dr. J. Johnson said, he could not conceive a case of jaundice in which there was not a mechanical obstruction to the natural flow of the bile in its course to the duodenum.

Dr. Clutterbuck said, another cause of jaundice existed, which, however, might be considered a mechanical one, and that was a spasmodic contraction of the duodenum, preventing the escape of the bile into it. The reason he supposed this cause to be in existence was, the observance of the very sudden manner in which jaundice is occasionally brought on from mental emotion, in persons previously in good health. The symptoms disappeared again in a short time.

Dr. J. Johnson said, the cause assigned by Dr. Clutterbuck was entirely mechanical; the biliary ducts themselves were subject to spasm, by which mechanical obstruction was in a like way produced. What was the best plan of relieving jaundice resulting from the presence of biliary calculi? Have we any power to accelerate the passage of these formations through the ducts? He feared we had not.

Mr. Kingdon considered if we did nothing to aggravate the cause of the stoppage, we could do little to assist in its removal, except, indeed, by mitigating such constitutional symptoms as presented themselves. Regarding the means employed in cases of biliary calculi, he would inquire whether antispasmodics, or those medicines which tended to promote the secretion of the liver, were the best. He thought he had seen much injury resulting from the use of opiates.

Mr. Hutchinson was in the habit of employing cupping over the affected part, with much benefit, in cases of jaundice.

Dr. J. Johnson had seen much mischief result from efforts made to remove biliary calculi, by such medicines as turpentine administered in the yelk of an egg, ether, &c. In ordinary cases of biliary calculi, or inspissated bile clogging the ducts, he thought the obstruction was removed by the *vis a tergo* forcing forward the bile. By this proceeding a paroxysm of pain and vomiting was produced (the action might be compared to the parturient efforts of the womb), and after a succession of these attempts the floodgates gave way; there was a gush of bile, and a relief to the symptoms. If this view, then, was correct, how could we facilitate the proceeding? He considered the vomiting to be an effort of nature to assist in the removal of the obstruction. Generally speaking, however, there was sufficient vomiting present, and emetics were not needed. Small doses of calomel and opium increased the secretion, and, therefore, the *vis a tergo*. These, with saline draughts, to quiet the irritable state of the stomach, and leeches, followed by chamomile fomentations to the affected part, he thought he had seen shorten an attack of jaundice.

Mr. Kingdon considered that Dr. Sangrado's plan, leaving out the bloodletting, would be of as much service as any other. Warm water taken into the stomach would act as the best antispasmodic, and tend to increase the secretion. It would also encourage the vomiting; the latter would relax the system, and favour the passage of the obstructing bodies.

Dr. Bennett thought we might do good by favouring the vomiting; vomiting, it would appear, took place when the spasmodic action in the duct occurred. Now he considered that if we could produce vomiting when this irritation was not present, it would be much more likely to favour the passage of the obstructing formations. He thought that quieting the irritation by opiates, and then administering emetics, would be of benefit. One of the most interesting questions the Society could entertain, would, perhaps, be the consideration of the best plan of preventing the recurrence of biliary calculi when they had been once expelled.

Dr. Clutterbuck did not think it difficult to lay down rules as to the mode of proceeding to be adopted, but their successful employment was another matter. He believed the obstruction arose from spasmodic contraction, and that the spasm ceased of itself, after a certain time. He believed some persons were in the habit of passing biliary calculi for a long period of time. These differed in size, from that of a shot to a small pea, and were voided daily, after the patients' suffering from their passage. These bodies could be easily detected on a close examination of the evacuations. As the spasmodic contraction was probably the cause of the obstruction, opiates and the soothing system, with warm bathing, &c., would be beneficial, as tending to relieve the spasm. He thought the best way to prevent the recurrence of biliary calculi was to alter entirely the action of the liver, and consequently the character of its secretion. It was probable that any change in the action of the liver would produce this effect; thus, occasional vomiting was advisable; frequent mild purgation more so. These, and putting the patient under the influence of mercury, and keeping up the action in a mild way, for a short period, he had seen succeed in preventing a recurrence. If he discovered any signs of inflammation, then moderate bleeding was resorted to; he was not aware of any other means that could be serviceably employed.

Mr. Headland said, that many cases of jaundice existed without pain, the obstruction resulting merely from the presence of inspissated bile. This cause was, to a certain extent, mechanical. He considered members had not looked far enough for the cause of the obstructions, which must be, he thought, in the deteriorated blood itself; if so, what was the most useful way of proceeding? All the remedies which had been named were, no doubt, proper remedies, yet could any one of these be said to be a certain cure? even when mercury was given the practice must be, to a certain extent, empirical; the effect of mercury on the blood was not known. Besides, could mercury be given in these cases without injury? He believed patients with chronic liver affections, who constantly resorted to this remedy, were as frequently killed as cured by it. He thought better remedies than mercurial ones could be employed. Alkalies, it was well known, purified the blood, and rendered it thinner; it was more probable, then, if alkalies or acids were given, the blood might be so influenced in its quality as to cure the disease.

Dr. J. Johnson said, that in persons liable to frequent attacks of jaundice, the bile, if the motions were carefully examined, would be found to be tenacious and ropy. He agreed with Dr. Clutterbuck, that small doses of mercury would render the bile more copious, and of a better character; there was no occasion to go into the theory of the formation of bile in arguing on this question. Regarding alkalies, he had employed them for a long time with those medicines which act on the secretions, such as iodide of potassium, iodine, nitrate of potash, taraxacum in particular, and small doses of mercury, with the greatest benefit.

Mr. Kingdon believed that the diet, after all, was the chief remedy against the recurrence of biliary calculi. Bile was formed from the blood proceeding towards the liver, in the veins of the intestines, and if veins acted as independent absorbents, as some believed, how necessary was it that the contents of the alimentary canal should be as pure as possible. Regarding the use of alkalies, as they afforded immediate relief, they were great favorites, but the constant use of them was highly dangerous; he had seen purpura and urinary disease result from it.

Dr. J. Johnson thought that the last speaker had an unnecessary *alkaliphobia*. Mischief, it was true, might result from the wholesale use of alkalies given without any determinate reason, but when acids were present in the stomach, the alkalies did not pass into the circulation, but mixed with the acid. He (Dr. Johnson) had taken alkalies daily for years, and always carried them about with him; they afforded great relief to acidity, and kept his urine clear; indeed, had it not been for alkalies, he should have been dead long ago.

Mr. Proctor considered that small doses of mercury were beneficial in cases of jaundice, by their effect in equalizing and improving the quality of the circulating fluid. In anomalous diseases, mercury, by producing an alterative effect on the system, produced a cure; he cared not how it acted so long as it led to the latter result. Every practitioner, of course, carefully watched the effect of mercury; he had seen little of the bad effects said to be the results of the use of this medicine.

Mr. Headland would still contend for the necessity of studying more carefully the remote causes of disease, the neglect of which he believed had interfered with our knowledge of remedies; and hence, as a celebrated writer has justly observed, at the expiration of fourteen hundred years we had knowledge of only two specifics, mercury in syphilis, and sulphur in itch. The nature of the blood was not well understood; and when we looked at the effect of lemon-juice in that horrible and loathsome disease, scurvy, we could not too strongly insist on a knowledge of the remote causes of disease. He would refer the members to the valuable lectures by M. Magendie, now publishing in the 'Lancet,' on the blood, for some important facts on the effects of introducing alkalies, &c., into the circulation.

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