Laryngology and Otology

(*Founded in* 1887 *by* MORELL MACKENZIE *and* NORRIS WOLFENDEN)

March 1943

ON RHINOLITHS

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ADDITIONAL reviews of the literature concerning rhinoliths appear superfluous when those by Demarquay, Seeligmann, Seifert, Hérisset and Key-Åberg are recalled. Twenty years have elapsed, however, since publication of the latter's review, and recent papers have at times included generalizations which are not in accord with former conclusions ; it seems opportune, therefore, to re-examine the evidence.

The preparation of a complete bibliography proved impracticable, since a number of reports are in journals which are inaccessible. Opportunity to study the lesion at first hand has, as yet, to occur, despite a growing collection of nasal material.* An abundance of evidence, however, has been published, and the present review is based upon verified reports, many well furnished with detail, of 257 rhinoliths, amplified by limited information concerning a further 127 cases.

Historical and Bibliographical Observations

Despite their rarity or, perhaps, because of it, rhinoliths have attracted considerable attention. During the sixty years between 1880-1940, for example (with the exception of 1920), at least one new case was reported each year. The majority are isolated case reports since opportunity to collect even a small series is rare. Morell Mackenzie described but two patients ; Lantin and Joukovsky each had four, and Garel, Chiari and Guttmann each had five cases. There were five cases at Moure's clinic, of which three were described by Moure and two by Monnié. The review by Key-Åberg includes an account of eleven rhinoliths, but only four are accompanied by clinical details, and, of these, one is a republication, with added details, of Holmgren's case. The largest individual series yet recorded appears to be the seven cases described by Graaf (1932).

* See Addendum, p. 116, for Pavey-Smith's case.

https://doi.org/10.1017/S0022215100011002 Published online by Cambridge University Press

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Mathias di Gardi, 1502, is frequently stated to have given the first account of a rhinolith, but Demarquay, probably the only author to have read the original text, excluded it from his collection of fifteen reports. It appears that di Gardi merely mentioned that a colleague had seen a rhinolith, as big as a pine cone, expelled by a patient. The earliest reports, therefore, are those of Bartholin, 1654, one of which is the first rhinolith with a cherry stone nucleus. An antral rhinolith was described anonymously in 1686, the report being frequently credited to Lanzoni (1738); it would appear that Lanzoni merely republished the earlier report. Oppikofer compared the two Latin texts, which are reprinted in his paper, and, after demonstrating their similarity, concluded that " Aus allen diesen Gründen sind wir berechtigt die Beobachtung von Lanzoni anzuweifeln ".

Although the conclusions in Demarquay's review may now be obsolete, it remains, as Mackenzie predicted, the principal source of information concerning the early cases. Demarquay's abstracts were apparently reprinted by Monnié and, in turn, by Didsbury. The bibliography which accompanies Seeligmann's dissertation was republished with a few amendments and additions by Hall, but, being of earlier date, it is less useful than that compiled by Hérisset. Seifert's review, in Heymann's Handbuch, is perhaps the best known but it is mainly an indigestible and not always accurate compilation of facts and authors' names. The bibliography is almost exhaustive but Key-Åberg was able to amplify it, notably in respect of certain rhinoliths which contained cherry stones. Key-Åberg's review is comprehensive and supported by an account of eleven rhinoliths.

Information concerning rhinoliths described by Russian authors is largely inaccessible but some account of them is given by Joukovsky.

Antral rhinoliths, which still appear to be limited to only six authentic cases, were reviewed by Oppikofer, whose report of the fifth is, as yet, the most comprehensive description of one of these stones.

The term rhinolith, " mot que ne préjuge rien sur leur nature ", is ascribed by Demarquay to Graafe, who also formulated, on slender evidence, the theory that rhinoliths are a manifestation of gout. Demarquay's criticism should have proved sufficient, for all time, to demonstrate its futility. Only one other patient, who suffered coincidentally from gout and a rhinolith, appears to have been described (Curtis). Cozzolino is said to have first made the distinction between " true " and " false " rhinoliths (Didsbury, Trimarchi).

The Incidence of Rhinoliths

Collected cases, totalling fifteen in 1845 (Demarquay), were increased to 110 by Seeligmann (1892), and to about 300 by Key-Åberg (1921-22). During 1910-25, a period which slightly overlaps that covered by

https://doi.org/10.1017/S0022215100011002 Published online by Cambridge University Press

Key-Åberg, there were 49 reports (Bailey), 14 more during 1925-33 (Morwitz), and another 7 during 1933-36 (Snyder and Feldman). Reports by Tsugawa (1937), Kravchenko (1938), Bleicher (1939, two cases), Costen (1939), Bomfim (1940), Hutcheon (1941), Arauz and Belou (1941) and Goodyear (1942) have since appeared. No mention is made by Snyder and Feldman in their text or references of the reports by Ito (1935), Bergstrand (1936, four cases, of which only one is a detailed report), Tessier (1936, two cases), and Enokov (1936). It is thus seen that to date about 387 rhinoliths have been described.

The present search yielded information concerning 384 rhinoliths. If the 111 other authors, who appear to have written about rhinoliths, but whose references are inaccessible or inadequate, be credited with one case apiece, the total on record, by this mode of estimation, is about 495.

It is often stated that children frequently insert foreign bodies into their own, or other children's noses. Keen (1930) has shown, however, that there were only 30 nasal foreign bodies amongst 15,000 children, and 16 of the patients were promptly cured at their first visit. If this is a representative observation, as it seems to be, it is not surprising that rhinoliths are rare. The introduction of medical inspection of school children and an increase in the general standard of education are also factors calculated at least to prevent an increase, if not to cause a reduction, in the incidence of rhinoliths.

Definition

A rhinolith is the result of complete, or partial, incrustation of an intra-nasal foreign body, usually of exogenous, but occasionally of endogenous origin. The term is also used to include similar concretions found but rarely in the antra and nasopharynx. Exogenous foreign bodies include objects like fruit stones, particularly cherry stones, buttons, or paper; endogenous foreign bodies include dried blood clot, misplaced teeth, sequestra and, perhaps, dried nasal secretion. Incrustation is, in the main, by phosphate and carbonate of calcium, derived largely from the products of inflammation.

Sex Incidence

A preponderance of females was first noted by Seeligmann, who found that amongst 110 patients, 62 were females and 29 males. Seifert and Hérisset believed the sexes were equally affected, but Key-Åberg confirmed the earlier observation when he found that 73 per cent. of the patients were females. The limited scope of their investigation, in the main of records of only 16 patients, probably led Snyder and Feldman (1936) to the conclusion that males were in the majority. The present survey finds that of 257 patients 146, or 56·8%, were females, and 95,

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or 37%, were males; the sex of 16, or 6·2%, was not stated. The greater frequency of rhinoliths in females is deemed significant, but no satisfactory explanation is offered. Seeligmann thought that it was accounted for by the fact that women blow their noses less frequently and less violently than men.

Age Incidence

Rhinoliths have been found in patients whose ages ranged between 3 and 76 years. Snyder and Feldman were by no means the first to record a rhinolith in a young patient, nor is their boy aged 6 years the youngest on record. Two boys, aged respectively 3 and 4 years, were described by Czarda, the youngest patients in the present series. There were reports, also, by Ball, Beach, Harrel and Hinde, of patients, aged respectively 4, 4, 5 and 5 years, and Key-Åberg's personal case was a boy aged 6 years. Only three patients were over 70; that of Calamida was 76, that of Hérisset and Ripault 74, and Keleman described one aged 73 years.

When grouped according to decade, the case incidence was: 1st, 15; 2nd, 44; 3rd, 47; 4th, 34; 5th, 38; 6th, 19; 7th, 16; and 8th, 3 cases. The ages of the remaining 41 patients were not stated. A maximum incidence occurred in the third decade, accompanied by a high incidence also in the second, fourth and fifth decades. The factors of latency, self-neglect and, at times, of erroneous diagnosis, contributed to load the later decades, for it must be recalled that these ages correspond with the time at which the rhinoliths were discovered.

The "danger" period for the entry of nasal foreign bodies was believed by Bross and Molinié to be during the first five years of life, but Key-Åberg thought this too narrow and preferred to extend it to the first decade. Undoubtedly the majority of foreign bodies, which were ultimately incrusted, entered the nose during childhood, as happened in 83% of cases reviewed by Key-Åberg. This is confirmed by the present enquiry. The clinical histories of 139 patients showed that entry during the first decade was unquestionable in 46 and a strong probability in 44 patients, i.e. 65%, with another 26 cases, or 19%, where entry during infancy was a possibility. By contrast, entry during adult life was certain or a possibility in only 23 cases, or 16%. This enquiry, however, supports Bross and Molinié rather than Key-Åberg in that the majority of children, who acquired foreign bodies, were then aged 5 years or less; only 6 of the 46 children, in whom there was an unequivocal history, were over 5 years old, at the time of entry of the foreign body. The adult group of 23 cases included two snuff takers (Böhm, Ruault); two incrusted teeth (Wepfer, Wright, J.); two "industrial" cases (cement, Smith, L. W.; felt, Ireland); three due to accident or operation (Mascarel, Krebs, and Snyder and Feldman); and only two of insertion of foreign

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bodies by adults (Tillaux and Crabbe) ; in at least another eight there is doubt whether the foreign body did, in fact, enter during adult life, as in the cases of Barraud, Baumgarten, Brown, Miller, Rebattu, Rohrer, Ruault, and Schiffers.

As Key-Åberg has observed, it is impossible to determine, on clinical evidence, the precise time necessary for complete incrustation. There are, however, a few reports which give an approximate estimate of this period. Tillaux's patient had inserted a cherry stone into her nose about three years before it was recovered as a rhinolith ; the interval in the patients described by Paterson and by Beach was about $4\frac{3}{4}$ and $2\frac{1}{2}$ years, respectively. Other rhinoliths, for example those recovered by Czarda and Gerber, by virtue of the age of the patient at the time, i.e. 4 and 7 years, and the clinical history, must have developed in from 2 to 5 years. The latter specimens measured 13 × 10 × 7 mm. and 20 × 10-15 mm., which suggests that at the end of about three or four years a rhinolith is likely to be only of relatively small size. Articles suspended in water from the " Dropping Well " at Knaresborough, water rich in lime salts, become " petrified " in from three months to two years, according to their size and texture. Although the circumstances are not precisely similar, this gives some idea of how long incrustation may take.

Pathological Anatomy

Rhinoliths are almost always single and unilateral. The right and left nasal fossae are involved with about equal frequency, a slight excess, probably of no significance, being noted on the right side. Amongst 257 verified cases, 104 rhinoliths were on the right and 96 on the left side ; 4 were present in the nasopharynx, 3 in a maxillary antrum, and in 3 patients rhinoliths were bilateral ; the site of another 47 was not stated.

Multiple stones were thought to exist in nine patients, other than those with bilateral stones. The specimens of Mackenzie, Jones, and possibly Cozzolino are the only likely examples, for in all the others, multiplicity is believed to have been due probably to the passage of fragments detached from a larger stone. Confirmation of multiplicity, by the demonstration of separate nuclei, has been afforded only in respect of bilateral rhinoliths. Mackenzie believed the fragments removed from one of his patients were probably, he made no stronger claim, parts of two stones, one of which measured 15 × 8 mm., and the other smaller. Jones's case was somewhat similar. Axmann's patient expelled several small stones, at intervals, over lengthy periods. Sneezing usually preceded the event, suggesting that they had been detached by its violence from a larger stone. Similar stones, of lentil size, were removed by Blandin from his patient (Demarquay). Nélaton removed a rhinolith the size of a pea from the nose of a young man and other stones, somewhat

https://doi.org/10.1017/S0022215100011002 Published online by Cambridge University Press

larger, were then expelled spontaneously (Rouyer); the circumstances of Allen's second patient were somewhat similar. Multiple stones were also described by Kern and Reverdin.

The case of bilateral rhinoliths, described by Nitsche, was accepted by Seifert with some hesitation as the then unique instance. Hopmann's patient had had a brief illness, with vomiting as a principal symptom. When examined thirty years later, both nasal fossae were filled with polypi; these were removed without relief, and, subsequently, two rhinoliths were found in the left, and a third in the right, nasal fossae. They probably originated during the earlier illness when cherry stones, as in Nitsche's patient, gained the nose. Birman-Bera (1931-32) briefly described another instance of bilateral rhinoliths, the nuclei of which were not mentioned.

Rhinoliths are uncommon in the nasopharynx. Birkett's patient "swallowed" a thimble, when aged 5 years. Nasal catarrh commenced a year later, and persisted until she was 23, when an incrusted tailor's thimble was removed from her nasopharynx. An incrusted metal regulator, part of an infant's feeding bottle, was removed by Paterson from the nasopharynx of a boy aged 6 years. When this patient was a baby of 15 months he had had an abrupt attack of dyspnœa, which was treated by inversion. The attack subsided, but thereafter nasal obstruction was persistent. Janatka removed a large rhinolith from the nasopharynx of a boy aged 9 years; this stone had obstructed both Eustachian tubes and predisposed to bilateral otitis media. Mr. E. W. Bain told me of a rhinolith, containing a signet ring, which he had removed from the nasopharynx of a patient; the ring was lost 50 years previously. Foreign bodies, apparently free from incrustation, were found in the nasopharynx by Hickman, who removed a steel ring which had been impacted there for $13\frac{1}{2}$ years, also by Lowndes, who removed a small brass ring, and by Milligan (1898), whose specimen was a red clay marble.

Oppikofer found the authentic records of only four antral rhinoliths, namely the anonymous report of 1686, republished by Lanzoni (1738), and those by Zuckerkandl (1892), Harke (1895), and Kahnity (1902). The fifth case (Oppikofer, 1908), concerned a doctor's widow, aged 60, who had had nasal trouble for some 20 years. Her principal complaint was an intermittent, unilateral, purulent nasal discharge. A rhinolith, the size of a hazel nut, 12 × 12 mm., weighing 0·98 gm., was found in the right antrum. Its chemical composition resembled that of nasal rhinoliths: water 1·66%, organic matter 11·91%, calcium oxide 40·72%, phosphorous pentoxide 40·52%, and magnesium oxide 3·81%; no nucleus was found. The stones described by Zuckerkandl, Harke and Kahnity were all of about hazel nut size. A sixth case, described by A. J. Wright in 1927, is the only one published since Oppikofer's review. This rhinolith contained the root of a molar tooth, displaced into the right

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antrum during extraction many years previously. Sinusitis of the antrum and frontal sinus was now present. After two operations to drain the sinuses, the stone was expelled spontaneously, gaining the nose through an opening in the antral wall made at operation several months previously. The rhinolith was approximately spherical and about 15 mm. in diameter; no analysis was made. Oppikofer failed to find any record of a rhinolith in any of the other nasal sinuses, and none has now been found. Non-incrusted foreign bodies, however, have been removed, not only from the antra, but also the frontal, sphenoid and ethmoid sinuses.

Lachrymal calculi are outside the present discussion, but their nasal association may permit a brief comment. Phillips and Cunier (1842) described a case and distinguished this kind of stone from rhinoliths. They mentioned that only four other cases had been reported up to that time, but several, e.g. by Mounier and Ónodi, have since been described. Bleicher had an interesting example of fictitious lachrymal calculi. A girl, aged 13, had for five years been troubled with a blackish secretion round the right internal palpebral angle and at intervals minute concretions, of 1-2 mm. in diameter, appeared suddenly from beneath the lower eyelid. In due course, the girl confessed that she had prepared these "stones" by moistening small pellets of cotton wool with her saliva; they were then blackened with charcoal and rolled into shape between the fingers.

The common situation for rhinoliths is the lower half of the nose, about midway between the anterior and posterior nares, and probably all of those which, when discovered, filled the nose, had begun in this region. Amongst 44 of the smaller stones, 37 were found in the lower half, and only 7 in the upper half, of the nose. The site usually mentioned was either on the floor of the nose, or in the inferior meatus, or between the inferior turbinate bone and the septum, at about the middle third, in the antero-posterior line, of the fossa. Bross found that 80 per cent. occupied the inferior meatus; Hérisset found this site, or the floor most often occupied. The stones described, for example, by Bovill, Hendley, Hutcheon, Poole and Zuckerkandl, were of considerable size and filled the nasal fossa; a few rhinoliths had extended into the opposite fossa or the adjacent antrum. Intermediate phases of rhinolith development are represented by the specimens of Fotiade and Hall, present in the inferior and the middle meatuses. Schmiegelow described inclusion of the inferior turbinate bone in a fork of calcareous material, an extension of a rhinolith in the inferior meatus.

The anterior limit of a rhinolith may be at, or even external to, the anterior naris. Some eight stones were within an inch of it, and, indeed, the stone in Bovill's patient, who himself diagnosed the condition, projected slightly from the nostril. Clutton's patient had felt the rhinolith with her finger.

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Recognition of the stone by posterior rhinoscopy was also occasionally reported as by Gorman, Lang, Moure, and by Polisar; in four patients, those of Faith, Francis, Kelemen and Polisar, the nasal stone extended through the choana into the nasopharynx.

Lateral enlargement of rhinoliths occurred more often on the septal than on the antral side, probably because the septum yields more readily. Severe septal deflection to the opposite side of the nose, in consequence of pressure by a large rhinolith was described by some 22 authors. There were at least seven more cases, those of Botey, Clauder, Cozzolino, Hessler, Presencia and Ucelay, Smith (L. W.), and Zuckerkandl, where the rhinolith had extended through the septum into the opposite nasal fossa. Extension into the antrum, according to the present search, was described by five authors, namely Hall, Hutcheon, Kelemen, Lobell, and Snyder and Feldman.

The measurements of 75 rhinoliths ranged from 9 × 6 mm., or $\frac{3}{8}'' \times \frac{1}{4}''$, (Lee Felt) to 55 mm. × 18 mm. (Poole). Small, medium and large stones were represented by those of from 9-20 mm., 21-30 mm., and 31-55 mm., in length. These three groups included 19, 39 and 17, respectively. Seifert cited Brown's as the largest rhinolith, no doubt because he believed it to be 5 cm. long. This stone, however, measured only $1\frac{3}{8}'' \times 1'' \times \frac{1}{2}''$ (34 × 25 × 12·5 mm.) and, although in the group of large stones, it was appreciably smaller than at least five other rhinoliths, for example, those described by Cosson, Hendley, Poole, Ruault and Zuckerkandl, each of which were at least 50 mm. long.

The weights of 84 rhinoliths ranged from 0·3 gm. (Heinemann), and 0·4 g., or $6\frac{1}{2}$ grains (Baber, 1885) to 110 grammes (Botey), and the latter seems likely to remain for all time the heaviest rhinolith on record. Error has occasionally arisen in respect of the rhinoliths described by Clay and by Hall, " grains " having been translated by some authors as " grammes ". These two stones weighed, respectively, 110 grains or 7·1 gm., and 92 grains or 6·0 gm., which at once withdraws them from the group of large rhinoliths. The majority, 51 of 84 rhinoliths, weighed 5 gm. or less. The present series of 84 included 13 of under 1 gm., 38 of 1-5 gm. and 16 of 5-10 gm., whereas there were only 17 of over 10·0 gm., but of these 8 were of from 45-110 gm.

Barraud appears to be the only author to record the specific gravity of a rhinolith, which was 2·21.

No author, as yet, has described a rhinolith which was wholly smooth, but several rhinoliths were grossly irregular. Bishop and Trimarchi, for example, likened their specimens to coral and Clay's wood-cut depicts a remarkably irregular stone. Hérisset compared the surface to that of pumice stone. Mammillation was occasionally noted, and the large stones usually formed an imperfect cast of the nose, as described by Agar, Doss, Hendley, Presencia and Ucelay, Taylor and others. Smaller stones were

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usually more irregular on the antral than on the septal aspect. There are two instances of annular rhinoliths. Nasal obstruction in Rendu's patient, a boy aged 12 years, was ultimately demonstrated to be caused by a rectangular stone, of about 15 × 15 × 3 mm., containing a central space about 8 mm. in diameter. Rendu believed that a small metal ring or a button had occupied the centre of the stone, and had been expelled spontaneously. The stone removed from Fearnley's patient, of whom few details are given, appears to have been similar.

The external surface of a rhinolith is usually a shade of brown, ranging from off-white to dark brown, in different specimens. Others were described as black or of greyish colour, and a few were tinged with green. The brown, and possibly black, tints, are caused by altered blood pigment, derived from capillary hæmorrhages, due to capillary erosion by the rough surface of the stones, many of which were slightly mobile. Suppuration and putrefaction are probably responsible for green or black discoloration. The internal appearances are not unlike those of vesical calculi, as first noted by Moriarty. The phosphatic material is of almost white colour, and somewhat granular. Again, as in vesical calculi, lamination was sometimes seen, as in the specimens of Bleicher, Bovill, Hutcheon, Ireland, Miot, Stoker, Symonds and others. Laminae in vesical calculi usually differ in composition, phosphatic layers being separated by, say, layers of uric acid. It has not yet been demonstrated what difference, if any, exists between the several layers of a laminated rhinolith. The consistence of many stones was distinctly hard, but there were others which were friable, and of chalk-like consistence.

Since all calculi, it seems, form around a nucleus, be it only a crystal, the distinction between rhinoliths as " false " and " true ", based on the presence or absence of a visible nucleus, has only the sanction of long usage to warrant its retention. It is suggested that rhinoliths be distinguished as either of exogenous or endogenous origin, to indicate the source of the nucleus.

Garel, Guttmann, Hérisset, Joukovsky, Key-Åberg and Seifert all supported the view that most rhinoliths contain an exogenous foreign body, a view which is now confirmed by published records. Middlemass Hunt found that 85% contained a nucleus, of which 80% were exogenous foreign bodies. Snyder and Feldman are almost alone in their view that " This form is not as common as the true type ". The present enquiry yielded evidence of 209 rhinoliths which contained exogenous nuclei. Even were it assumed, which is unjustifiable, since no examination was made in many cases, that the rest of the 384 rhinoliths contained endogenous nuclei, the former group is still the larger. Analysis of the 257 verified reports showed that 139 of these rhinoliths contained exogenous nuclei, whereas there were only 19 of endogenous origin. Incrusted teeth were present in 7, sequestra in 4, and blood clot was,

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perhaps, the nucleus of another 8, although this latter group is open to question. Only 31 of the remaining 99 rhinoliths appear to have been examined to discover a nucleus, and in 9 of these the negative examination was admitted to be inconclusive. In short, present evidence shows that the ratio of exogenous to endogenous nuclei is 139 : 19, or about 7 : 1.

Nuclei of Exogenous Origin

Although many materials, either mineral, vegetable or animal, have been found in rhinoliths, only a few were present with any regularity. It has long been recognized that cherry stones are frequently the nuclei of rhinoliths. No less than 75 are now traced ; the first was described by Bartholin in 1654. This high incidence of cherry stones amongst exogenous nuclei, 75 out of 209, or about 36 per cent., is more than fortuitous. Fruit stones, other than of cherries, together with peas, beans, nuts, berries, sunflower seeds and the more unusual nuclei, like caroub seed (Nemai) totalled only 34, or 16 per cent., of which one-half were hard fruit stones or nuts. The shape, size and weight of a cherry stone combine to favour a lengthy stay in the nose. The initial symptoms are likely to pass speedily and then a latent period, probably lasting years, as in Handford's and other cases, is to be expected. Moreover, until incrustation has advanced appreciably, the stone may be difficult to detect, even if symptoms occur. Other fruit stones, by virtue either of their larger size, or sharp surfaces, for example prune, apricot, date or olive stones, rarely occurred in rhinoliths ; large fruit stones of this kind are likely to be promptly removed. Peas and beans, which tend to swell considerably, soon cause severe obstruction, leading to prompt removal. It is somewhat surprising that orange or lemon pips are rare nuclei ; only one instance was found (Moure). In Russia sunflower seeds rank high as potential nuclei of rhinoliths (Joukovsky, Alskne).

Buttons, next in frequency, totalled 18, or only 8·6 per cent. of exogenous nuclei. Pieces of paper, some of which, as described by Seeligmann, still bore lettering legible under low magnification, were found in another 13, and pebbles or small stones were found in 8 rhinoliths. The low incidence of cotton wool, present in only 9 rhinoliths, is another surprising fact, when the wide use of cotton wool swabs in the nasal toilet of infants is recalled. Holmgren's patient aspirated a wool tampon from its mother's breast. Other exogenous nuclei included half a dozen beads (for example, Glas, 1919, Taylor, Law), two seashells (Major, Tanner), pieces of wood (Köhler, Joukovsky), slate pencil (Bark), black silk (Noquet), rag (Baber), cork (Chiari), rubber (Key-Åberg, Khan or Kan, and Krebs), a small screw (Jurasz), and a piece of twine (Snyder and Feldman). Two snuff takers acquired rhinoliths (Böhm, Ruault) ; Böhm's patient was addicted to " Schmaltztabak ", a Bavarian snuff

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freely adulterated with ground glass and chalk, of which the rhinolith, nucleus was composed.

Nuclei of Endogenous Origin

Teeth, misplaced into the nose either through developmental errors or trauma, occasionally become incrusted, but usually differ from rhinoliths, with the exception of A. J. Wright's antral rhinolith, in that they retain a point of attachment to some part, usually the floor, of the nasal framework. Presumably a tooth wholly displaced into the nose is promptly removed, and never forms a rhinolith ; it may rarely do so in an antrum. Graham described an extraordinary case in which a tooth, wholly displaced into the nose, was found embedded in the inferior turbinate bone " where it had taken root and was growing vigorously " ; it had been driven right through the superior maxilla. The first example of an incrusted tooth was described by Wepfer (1727) ; the sole remaining upper tooth, an incisor, of a woman aged 70, projected into the nose and became incrusted. Other cases were reported by Arauz and Belou, A. J. Wright, Jonathan Wright (two cases), Kayser, Baumgarten, Popoff, Glas (1907, republished 1913), and Seifert. Several nasal teeth have been described but only a proportion appear to have been incrusted. The nasal tooth, which was associated with, and probably the cause of " rhinitis caseosa " of 13 years' duration in Abercrombie's patient, apparently was not incrusted.

Although not a few rhinoliths were at first thought to be sequestra, the latter are rare amongst endogenous nuclei. The rhinolith in Cheatle's patient contained a fragment of bone ; because the inferior turbinate was absent when the nose was examined after the extraction of the rhinolith, he thought the missing bone had become a sequestrum, and later the nucleus of the rhinolith. There was clinical evidence of syphilis. Mascarel's patient differed only in that trauma, a blow on the nose by a bull's horn, was deemed the cause of necrosis of the inferior turbinate bone. The cases of Middlemass Hunt and Fethke were also of rhinoliths around sequestra. A piece of dead bone was found by Silitch in one of his rhinoliths, but no details are available. Bone, probably of exogenous origin, was also present in rhinoliths described by Chiari, and by Nourse.

Dried blood clot may occasionally cause mechanical obstruction and become the nucleus of a rhinolith. The best known and most convincing example is Moure's case, which is supported by adequate histological (Sabrazès) and chemical (Denigès) evidence. Others have described soft, bright or dark red material apparently clot, as a nucleus. Sanders found that the nucleus of Brown's specimen contained fatty matter and iron, but Irvine, who confirmed the presence of iron oxide in the ash, believed it exogenous. Utz found fibrin mingled with blood clot in Francis' specimen but, since he received only part of the stone, the presence of an

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exogenous foreign body was not wholly excluded. Spectroscopic demonstration of blood in Scheppegrell's specimen scarcely confirmed that the nucleus was blood clot; traces of hæmoglobin or other blood pigment in the incrustation would be difficult to exclude; spectroscopy was negative, however, in Clutton's specimen. Bright coloured material, believed to be blood clot, was found in the centre of Stoker's rhinolith. Other authors who suggested that the nucleus of their specimens was clot include Binder, Monnié and Wagner.

Although within the bounds of possibility, as first suggested by Plater (1736), dried nasal secretion has yet to be proved the nucleus of a rhinolith. Of the six examples cited by Seifert, Verneuil described "une sorte de graine, qui, par sa forme, rapelle la forme d'un pépin de raisin", in the fragments of his specimen. The abstracts by Didsbury and Hérisset of Berlioz's case go no further than to state that no nucleus was found. The original reports by Guttceit and Löwenthal are not available, but Chiari classed the former as a rhinolith without a nucleus. Hicquet's report has not been traced, Seifert's reference being incorrect. Voltolini's case is a debatable example. If crusts become nuclei, their rare occurrence in rhinoliths is surprising, since crusts are common in the nose.

The formation of rhinoliths around clumps of desquamated epithelium, bacteria or even a group of crystals precipitated from the nasal secretion, tears, or products of inflammation, is a possibility, but no instance has yet been proved. Admittedly proof is difficult, and this conclusion is permissible only when thorough investigation has been made. Morell Mackenzie said that "occasionally in the centre of the calculus an albuminous liquid or a fatty proteine substance has been found, but it appears doubtful whether in these cases the matter contained in the centre of the calculus was the remains of the original morbid secretion, or whether it was due to the softening of some foreign material primarily forming the nucleus of the stone." Of his second specimen, he said that no nucleus was found "but if there had been one it might easily have eluded observation", the stone having had to be crushed into small fragments to admit its extraction. By inference, but not by explicit statement, he suggested that all rhinoliths probably contained exogenous nucleus.

The Chemical Composition of Incrustations

Many authors give the results of qualitative analysis and at least twenty quantitative analyses have been reported. Geiger's analysis of Axmann's specimen in 1829, the first analysis on record, demonstrated 0·35 of animal material, 0·8 of calcium phosphate, 0·325 of calcium carbonate, 0·125 of magnesium carbonate with traces of soda, of muriate of soda and iron oxide. Subsequent analyses have confirmed that these constituents and the high phosphatic content are almost constant findings. The results are expressed by some authors in terms of

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phosphorus pentoxide and calcium oxide, whereas others state the amounts of calcium and magnesium phosphate and carbonate present. The fifteen analyses reported by Alskne, Bergstrand, Berlioz (four specimens), Hérisset (two specimens), Key-Åberg (two specimens), M'Wheeny, Melzi (two specimens), Moure-Denigès, and Polo are the basis of the following observations.

Incrustations, according to these analyses contained, on the average, 4·7% of water, 16·54% of organic matter, 59·20% of calcium phosphate (an average of 12 results), 5·73% of magnesium phosphate (an average of 10 results), and 11·60% of calcium carbonate (an average of 10 results). Other substances were present only in traces as a rule; appreciable amounts of iron or oxalic acid, for example, were exceptional.

Amongst these analyses, the constituents were within the following limits: water, from 2·9% (Melzi) to 6·9% (Berlioz); organic matter, 13·2% (Melzi) to 31·9% (Key-Åberg); calcium phosphate, 44·7% (Key-Åberg) to 79·5% (Melzi); magnesium phosphate, traces (Key-Åberg)to 19·46% (Hérisset), and calcium carbonate, traces (Moure) to 20·69% (Berlioz). Seifert found that the organic content ranged from 5% to 35%, Key-Åberg said it averaged 23%, and Trimarchi gives the range as from 15% to 20%. In the four analyses of Berlioz, organic matter was from 16·0% to 18·2%. Trimarchi found calcium phosphate ranged from 47% to 63%, calcium carbonate from 3% to 10% and magnesium phosphate from 9% to 20%.

The composition of the nucleus at times caused appreciable modification of that of the incrustation, notably when metal boot buttons were nuclei. These foreign bodies contributed iron salts to the incrustation, which contained 37·3% of iron in one of Seeligmann's specimens, 36% in Moeller's, over 30% in one of Baber's, and 15·1% in one of Key-Åberg's specimens. Oxalic acid amounting to 0·6% of an incrustation was demonstrated by Guttmann, who subsequently found traces of oxalic acid in two other rhinoliths, which also contained cherry stones; by contrast oxalic acid was absent from the incrustation of two rhinoliths which did not contain cherry stones. The source of the oxalic acid, therefore, appears to be the cherry stones, and some were dried and submitted to analysis; this sample contained 0·55% of oxalic acid (Polson).

The composition of antral stones, as judged by Oppikofer's analysis, already cited, probably differs in no material fashion from that of nasal stones.

The Route of Entry of Foreign Bodies

Exogenous foreign bodies usually enter the nose by the anterior nares, being inserted either by the patient or some other person. Occasionally the foreign body enters by the posterior nares and it is probable, as believed by Hopmann, that many, derived from food, enter

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by this route. This is predisposed to by vomiting, or retching, or unexpected sneezing, or laughter when the mouth contains food. Key-Åberg maintained that few foreign bodies entered by the posterior route and then more often in children than in adults. The clinical histories, as might be expected, rarely give precise details of the accident, because the long interval, which usually elapsed between the entry and removal of the foreign body, had obliterated memory of the earlier event. Moreover, the initial symptoms were usually transient.

The cherry stones removed by Fotiade, Handford, Ripault and Tillaux, were all inserted by the patients, but entry by the posterior route occurred in Minkewicz's patient during an attack of vomiting. The miller described by Horn (1788) aspirated a cherry stone while eating cherries. Deschamps described a case of obstruction of the left nasal fossa by a piece of bone. Twenty-five years previously, while the patient was taking soup, a piece of bone stuck in his glottis. After a paroxysm of coughing and partial asphyxia, it was ejected, passing upwards to gain the nose *viâ* the posterior nares.

Foreign bodies occasionally gain the sinuses and, less frequently, the nose, as a result of trauma. Several of these reports concern the misplacement of apparatus used to drain an antrum, through the socket of a tooth. Illustrative cases include those described by Abad and Magboo, Ballenger, Barola, Moore, Reynolds, Voorhees and Weill. These foreign bodies, however, do not appear to have been incrusted, and no instance of the kind has been found. In the light of these records, the scarcity of antral rhinoliths and their absence in all other sinuses, would suggest that certain factors necessary for incrustation are lacking in the sinuses.

Patients with developmental defects, such as a cleft palate, may acquire nasal foreign bodies by these abnormal paths, but no instance, however, appears to have been recorded. There is one report of a foreign body which entered the nose through a palatal defect of pathological origin. The velum and arch of Khan's patient were destroyed by syphilis, and a prosthetic appliance was fitted to occlude the defect, through which, however, it entered the nose.

The lachrymal duct is another possible route of entry of foreign bodies, although likely to be concerned only in exceptional circumstances. Onodi, it appears, described a lachrymal stone in the nasal cavity, and the cases of Mounier and Fauré are cited by Key-Åberg. That of Mounier, however, is a lachrymal stone, formed around a small glass cannula used, some forty years previously, to clear the duct. The stone was found in the duct and removed *viâ* the nose ; it was not a rhinolith.

Ætiology and Pathogenesis

The principal factor which predisposes to rhinoliths is the entry and lodgement of a foreign body in the nose. This, however, as several

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reports show, is not of itself a sufficient cause. Antral foreign bodies are not rare, yet their incrustation is distinctly uncommon and by no means all foreign bodies which lodge in the nose, and which remain there many years, become rhinoliths. It is necessary that the lodgement of a foreign body instigates suppuration. Mechanical obstruction to the escape of pus, by the foreign body and other sources of obstruction, expose it unduly to air currents in the nose and, in consequence, the pus is concentrated beyond the point at which salts, notably those of calcium, will remain in solution. They are then precipitated on the surface of the foreign body and in time it becomes incrusted. Inspissation of pus by a similar process is also responsible for the complication of "rhinitis caseosa" (Polson, 1942). The rarity of antral rhinoliths is probably to be explained by the absence of air currents in that backwater of the nose, or, at any rate, the absence of currents comparable to those in the nasal fossae. In both there is the factor of obstruction to free escape of pus, and, indeed, this is probably greater in the antrum than in a nasal fossa which contains a foreign body.

The origin of the calcium salts has been debated. Some have favoured the tears and others, nasal mucus. Tears apparently contain traces of calcium (Demarquay). Although tears may, in small part, be a source of incrusting salts, there is little doubt that the principal source is pus. Samples of pus were analysed, and yielded the following results: (*a*) peritoneal exudate from a case of general peritonitis, complicating an appendix abscess: calcium content: 0·31%, dry weight; (*b*) pericardial exudate from a case of suppurative pericarditis: calcium content: 0·13% dry weight ≡ 11 mg. Ca. per 100 c.c.; phosphate content: 32·3mg. inorganic P. per 100 c.c. ≡ 102 mg. phosphoric acid per 100 c.c.; (*c*) peritoneal exudate from another case of general peritonitis, complicating appendix abscess: calcium content: 0·15% dry weight ≡ 17 mg. Ca. per 100 c.c.; phosphate content: 36 mg. inorganic P. per 100 c.c. ≡ 116 mg. phosphoric acid per 100 c.c. Nasal pus was not available. The phosphate values were artificially raised by post-mortem change, but like changes probably occur in pus retained in the nose.

The pathogenesis of rhinoliths of endogenous type is similar when the nucleus is a misplaced tooth, sequestrum or perhaps dried blood clot. Those without demonstrable nuclei are less easy to explain. It is a reasonable supposition, however, that the mechanism is not unlike the formation of crystals from a super-saturated solution. The suspension of even a single crystal of the solute in this solution is sufficient to initiate crystallization. A foreign body is not the only source of mechanical obstruction in the nose, and, as has been discussed elsewhere (Polson, 1942), the nasal anatomy of itself, swollen mucosa, granulation tissue or mucous polypi have at one time or another operated to cause inspissation of pus in the nose. In due course precipitation of calcium and magnesium

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salts may enclose desquamated epithelium, a clump of bacteria or, possibly, a crust, which becomes the nucleus. Precipitation of salts is also probably favoured or accelerated by changes in the hydrogen-ion concentration of the nasal secretion, as has been shown in respect of biliary calculi.

Trauma played a part in the origin of some rhinoliths. Prior operative treatment was responsible for the genesis of a rhinolith in four cases; a gauze swab was overlooked during an antral operation, and found three years later in a rhinolith (Snyder and Feldman),* the misplacement of a laminaria provided the nucleus of another, dental extraction was responsible for rhinoliths in the patients described by Johnathan Wright and A. J. Wright; in the former a fragment of tooth, $\frac{3}{4}$ in. long, penetrated the nasal floor and became incrusted, and in the latter the root of a first molar was displaced into the adjacent antrum, ultimately to become the nucleus of a rhinolith. Blows on the face or nose also appear to have been the initial factor in six cases; Agar's patient sustained a kick from a horse, those of Allen and Mascarel were struck on the nose, and those of Clay, Hérisset and Felici fell on their face. In another patient a wheat grain was forcibly driven into the nose and ultimately became a rhinolith (Krebs).

Industrial conditions are also a factor in the causation of some rhinoliths. Betz, in a brief statement, without illustrative cases, said that 10 per cent. of workers acquired rhinoliths from cement dust, which also predisposes to septal perforation. L. W. Smith is the only author now found to have described a case. Joukovsky mentioned that rhinoliths may occur amongst workers in cloth and in salt mines, but no illustrative case reports have been traced.

The Symptoms and Signs of Rhinoliths

A detailed account is not attempted, but there are certain changes which may be discussed, either because of their frequency, or because of their interest.

It is clear that almost all rhinoliths will, sooner or later, make their presence known. Only four in the present series were found by chance in the course of a routine clinical examination. One patient was an apparently healthy naval rating (Camerer), another complained of laryngitis (Guttmann) and the the third of otitis media, in no way a complication of the rhinolith (Bishop). A fourth is described by Hirschmann as a chance finding, but the patient had had slight obstruction of the right nose. Although Fearnley described his specimen as "discovered by accident", the patient had had an offensive unilateral nasal discharge for months. Pavey-Smith's specimen was found during operation for sub-mucous resection of a deflected septum.

* See also Pavey-Smith's case, in the Addendum.

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Symptoms at the time of entry of the foreign body were usually of minor character and were often long forgotten by the patient. A latent period, even of several years, may follow, as is well illustrated by the patients of Handford and Sewell. This interval may be symptomless, but, sooner or later, some of the changes described below will appear, and their relief follows only when the cause is determined, and the rhinolith removed.

Although a number of symptoms have been ascribed to the rhinoliths, few occurred with outstanding regularity. Unilateral nasal discharge was particularly common. Almost all patients, as judged by about 180 reports which mention clinical details, had had a nasal discharge, which was usually purulent, often fœtid and sometimes blood-stained, as noted in at least 114 of the histories. Simple catarrh, on the other hand, was exceptional, and mentioned in respect of only seven patients, in one of whom it was of sudden onset. Absence of discharge was specifically mentioned only by McBride and by Nourse.

Unilateral nasal obstruction, either as a complaint or as determined by examination of the patient, was almost as common as nasal discharge. Obstruction was recorded in at least 92 reports, and occasionally, owing to displacement of the septum, it was bilateral. The onset of obstruction was a gradual process, often taking several years to become complete, an indication of the time required for the evolution of rhinoliths, even of moderate size. In several patients obstruction preceded the discharge by many years, for example, obstruction existed in one of Garel's patients for forty years, whereas the discharge was present for only one year.

Nasal discharge and obstruction are the two cardinal symptoms, and co-existed in at least 56 patients.

Epistaxis, at least mild, might also be expected to be common, since many rhinoliths are rough and somewhat mobile, and are likely to damage the nasal capillaries. Epistaxis was reported, however, in only 17 patients, in two of whom (Francis, Jana) it was deemed the cause and not a result of the rhinolith. Even when bloodstained discharge be included as " epistaxis " the total is raised by only another seven cases.

Certain other symptoms or signs comprise a " syndrome ", which characterizes rhinoliths which have been long neglected, and have attained appreciable size. These include : swelling of the nose or face (24 cases), epiphora (14 cases), and conjunctivitis (3 cases) ; the ocular troubles arise from obstruction of the lachrymal duct.

Headache is sometimes mentioned as a cardinal and some speak of it as a constant symptom (Noquet), but in this series it was a complaint of only 23 patients. Headache may be intense, and is not infrequently localized in the frontal region. There were 8 instances of neuralgia, 5 of migraine, and 2 of attacks of giddiness (Tormene, de Santi).

Mouth breathing (5 cases), and a nasal voice (3 cases), were uncommon

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symptoms. Anosmia occurred in only two patients; three others complained of vomiting, and only one had dysphagia. Other occasional symptoms included: the sensation of a foreign body in the nose, nasal discomfort, attacks of sneezing, and excoriation of the lip. Unilateral sweating of the face, in Schmiegelow's patient, appears to have ceased some time before the rhinolith was removed; he explained this on the ground that the stone, being enlarged, had later paralysed the nerves responsible. Joukovsky also noted this sign in one of his patients.

Granulation tissue, or inflamed mucous membrane,* or mucous polypi, may lie anterior to the stone and obscure it; at other times a deflected septum may preclude satisfactory anterior rhinoscopy.

There may be ulceration of the nasal mucosa, and destruction of the septal or antral walls. Perforation of the palate, of syphilitic origin and not due to the rhinolith, was mentioned by Khan (or Kan). Displacement of the palate by a rhinolith, as in Bovill's patient, is rare. Atrophy of the inferior turbinate bone occurred in seven patients, and in another two, this bone was absent and apparently became the nucleus of a rhinolith. Deflection of the septum to the side opposite to the rhinolith occurred in 22 patients. Signs which are peculiar to the stone may be inferred from the description of the morbid appearances (v.s.). It suffices, here, only to stress that the discovery of a hard body in the nose by probe examination is of prime importance.

Duration of Symptoms, and Stay of Foreign Body

The times sometimes quoted to express the duration of symptoms are actually those during which a foreign body had been in the nose or antrum, and the two periods are rarely identical; a foreign body frequently remains in the nose for a considerable time before symptoms, other than those which attend its entry and soon pass, are apparent. The foreign body present in Sewell's patient for 44 years eventually caused symptoms of only four months' duration; Thost's patient was similar. The division of symptoms into the three phases, initial, latent or incubation, and inflammatory has its merits (Trimarchi, Tormene).

Foreign bodies may stay in the nose for remarkably long periods, even for sixty years (Thost, Weismann). One of Guttmann's patients, aged 62, probably acquired the foreign body when he was aged 12. The presence of a foreign body for 50, 46, 44, 40 (2 cases), and 30 years (3 cases), was probable in the respective patients of Guthrie, Hirschmann, Sewell, Cosson, Krause, Hopmann, Bleicher and Tanner; another instance of long retention of a foreign body, for 27 years, was also described (Handford), and in another four patients the stay was assessed at 20-25 years (Fotiade, Hajek, Power and Verneuil).

* See Stirk Adams's case, in the Addendum.

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Symptoms, although usually of shorter duration than forty years, have none the less lasted for remarkably long periods. Baelde's patient had had symptoms for 33 years, and Ingersoll described a patient, who had had symptoms for 30 years ; J. F. Hill's patient suffered for 25 years. Although these are extreme examples, 116 clinical histories, which relate the duration of symptoms, are mostly in agreement in showing that the time is to be measured in years rather than months. Symptoms which lasted less than one year were recorded of only eleven patients, whereas there were 69 patients whose symptoms had lasted from one to ten years, and in another 17 for from 11 to 40 years ; 19 patients had had symptoms for an unspecified number of years.

The length of time which patients have tolerated their symptoms is noteworthy, especially when the unpleasantness of nasal discharge and obstruction is borne in mind. A few have been unfortunate in their doctors, but it seems that the real cause of this tolerance is a low grade mentality. When stated, the occupation of the patient is usually of the labouring kind, whereas only two professional men, Baber's medical practitioner and a clergyman (Allen, case 2), appear to have had rhinoliths; Baber's patient had symptoms for only three months. Although rhinoliths have occurred in his hospital clinic, Mr. E. W. Bain has never had a case in private practice.

Diagnosis

Tanner (1862) stressed the importance of a search for intranasal foreign bodies in all cases of ozaena and many reports indicate the value of probe examination in this search, and its importance in the exclusion of malignancy (e.g. Hewetson's case). In skilled hands, this simple instrument appears to be a sure means of detecting rhinoliths and other intranasal foreign bodies, even though it may not determine their precise nature. The records of patients, in whom accurate diagnosis was for long delayed, usually indicate that delay was in the main due to the omission of probe examination of the nose. Spicer said that : " Foreign bodies in the nose in children, from the smallness of the channels and from the swelling—usually secondary to previous attempts at removal, or to consecutive rhinitis—are not usually to be detected, even by skilled rhinoscopy, and the diagnosis must depend on the probe." Didsbury and, later, Guttmann, also emphasized the value of probe examination.

Radiological examination of the nose was apparently attempted for the first time in this country by Macintyre, who, in 1900, described the use of Röntgen rays in the detection of an antral foreign body. Scheier published a radiogram of a metal body in the nasal cavity in 1897.

Ruault, in 1904, having diagnosed a rhinolith on clinical evidence,

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proceeded to determine whether it was opaque to X-rays. Hérisset says, of Ruault's first case, that a central zone, of oval form, occupying the site of the cherry stone subsequently removed, was noted in the radiogram; the second rhinolith was also opaque, and there appeared to be a fissure in it, apparently between the incrustation and the nucleus. Radiology does not appear to have been applied to the diagnosis of rhinoliths during the ensuing twenty years. The next mention of it is in a brief note by Glas (1925); the case reported by Kelemen, 1926-27, is illustrated by two excellent radiograms; Lobell's (1927) two patients were submitted to X-rays, and the findings were interpreted as evidence of bone necrosis in the nasal floor; the radiogram of Locy's (1929) patient showed a particularly dense shadow, of circular outline, involving the nasal floor, and inferior turbinate bone; the appearances were thought those of an osteoma. Radiograms were also made of one of Joukovsky's (1931) patients, of Polisar's (1933) two patients, of those of Snyder and Feldman (1936), of Runge (1931-32) and of Hutcheon (1941). When radiograms have the quality of Kelemen's illustrations they cannot fail to assist diagnosis, but the requisite staff and apparatus are not always at hand and, in consequence, the probe is likely to retain its supremacy. Radiology may, perhaps, excel in the assessment of any damage to the nasal framework, but most reports indicate that even large rhinoliths may have but slight destructive effects upon the nasal interior.

Prognosis

Once the stone is detected, and successfully extracted, prompt relief from symptoms, and a speedy return to normal, despite years of prior suffering, may be anticipated. It is somewhat surprising that even large rhinoliths, with the attendant difficulties of removal, were usually unaccompanied by gross structural damage. In only a few cases was there atrophy or loss of the inferior turbinate, or erosion of septal or antral walls. The fatal termination in Key-Åberg's case is apparently unique.

Complications

Rhinoliths were almost without complications, despite the long periods for which many of them had remained in the nose. Except for " rhinitis caseosa " and secondary sinus inflammation, other complications were unusual, if not rare.

" Rhinitis caseosa " is but a variant of suppurative rhinitis, in which obstruction to the escape of pus causes its inspissation, with the production of distinctive clinical phenomena. Although rhinoliths, together with foreign bodies, granulation tissue and like mechanical obstructions are important factors in its causation, " rhinitis caseosa " was present as

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a complication of only thirteen rhinoliths. Of these cases, the reports by Calamida (three cases), Handford, Hill, G. W., Moure, de Rosa and Verneuil are generally known, but this opportunity is taken to add five cases which escaped attention in my former review (Polson, 1942).* A " rhinolith combined with cholesteatoma of the maxillary antrum ", the findings being essentially those of an established " rhinitis caseosa ", due to a rhinolith, was described by Hutcheon, 1941. The cholesteatoma theory, however, is a long time a dying. Mascarel's (1852) report is also of another good example which has been generally overlooked. He described the powerful fœtor as an " odour sui generis ", apparent when entering the patient's room. A rhinolith was detected and its removal was followed by the spontaneous expulsion of " une grande quantité de la matière ichoreuse "; it will be recalled that this report appeared some twenty-two years before Duplay introduced the term " coryza caséux ". Moriarty's case (1886) is another good example which has also been overlooked. He described the expulsion, subsequent to the removal of a rhinolith, of " a quantity of greyish-white, putty-like material, not unlike brain matter, finishing with a huge plug which evidently had occupied the posterior nares ". The cases of Ruault-Hérisset and Key-Åberg are less certain examples of " rhinitis caseosa " but the former wrote of a rhinolith " inclus dans de masses caséuses " and the latter of a little caseous material and pus lying behind the rhinolith.

Sinusitis or sinus empyema were mentioned in less than twenty reports, and the view of Seifert, who mentioned only Morelli's case, that this is a rare, or unusual, complication is confirmed. Gorman, on the other hand, believed it a usual finding, but Key-Åberg, in addition to his 3rd and 4th cases, collected only five others reported after 1900, namely, by Gerber, Krebs, von Gámán, " Barranel " and Lange (1913), and of these, he questioned that of Barranel (i.e. Barraud), because the diagnosis rested only on transillumination. During the ensuing twenty years, sinusitis was mentioned in only nine new reports, namely, those of Bleicher (case 2), Gorman, Guttmann (case 5), Hutcheon, Kelemen, Lobell, Snyder and Feldman (cases 2 and 3), and A. J. Wright. Involvement of the sinuses is usually restricted to the antrum adjacent to the rhinolith. There are, however, five instances of multiple, unilateral sinusitis described respectively by Gorman, Key-Åberg, Snyder and Feldman (2 cases), and A. J. Wright. In view of this evidence, and with due allowance for any omissions, it is not correct to say that " the involvement of the sinuses on the affected side was commonly observed in most of the reported cases ".

Ear trouble, notably middle-ear disease, is a rare complication of rhinoliths. According to Key-Åberg, otorrhœa and deafness were mentioned by Cozzolino and otitis by Sokolowski and Tormene ; sclerosis

* See also Stirk Adams's case (1943), in the Addendum.

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of the middle ear and labyrinthine disease occurred in one of Rohrer's patients. The present search discloses only one other instance of otitis media due to a rhinolith, seen in Janatka's patient, already mentioned. Although Milligan's patient (1896) had otitis, this was not ascribed to the rhinolith.

One instance of septal abscess was recorded (Minkiewicz). These, apparently, are nearly all due to trauma, and a rough, hard, and sharp foreign body, like a rhinolith, might be expected to cause this complication more frequently. Runge found an abscess of the inferior turbinate bone in his patient. There are a few instances of long neglected rhinoliths, associated with fistulae between the nose and face, but there is only one of an orbital abscess (Key-Åberg, case 3). This patient suffered almost all the possible complications of a rhinolith and eventually died of meningitis, secondary to the abscess in his orbit. This still remains the only fatal case in the literature.

Tormene described a patient who had, amongst other troubles, epileptiform convulsions, cured by the removal of her rhinolith. Rohrer's patient had a " reflex neurosis " cured in like manner. No instance of asthma as a complication was traced, but Guttmann said that reflex asthma had been cured by removal of a rhinolith.

Treatment

The majority of the stones were extracted anteriorly by traction with suitable instruments. Larger stones required piecemeal removal, or they had to be crushed, in order to remove them. Most were removed *viâ* the anterior nares, but some had to be displaced backwards into the naso-pharynx, whence they were removed by the surgeon, or expectorated by the patient. It is a manœuvre which obviously requires precautions against the displacement of the rhinolith into the larynx or trachea, if the patient be under general anæsthesia. Radical operations were occasionally undertaken to deal with the large stones, for example by Myerson, Hendley and Kelemen. Hæmorrhage is the principal operative complication and, although Gorman found it " terrific ", and Doss " profound " only six others comment on its severity, whereas there are several other records, which state that only slight hæmorrhage occurred. It seems that in all cases, suitable measures soon brought the hæmorrhage under control.

Spontaneous expulsion, in response to an irritant inhalation, for example, snuff, may take place (Axmann's case), and might be attempted as a preliminary step, if there is reason to believe the stone is small. Brodie's patient, for example, expelled the stone on blowing her nose, as did A. J. Wright's patient, six weeks after two radical operations for sinusitis.

https://doi.org/10.1017/S0022215100011002 Published online by Cambridge University Press

On Rhinoliths

Acknowledgment

I thank Miss L. E. Worth for assistance in the preparation of the manuscript, and Mr. N. S. Green for technical assistance. The compilation of the bibliography is my own responsibility, but the majority of the papers examined have been obtained with the assistance of the Librarian and staff of the Royal Society of Medicine.

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CHENDER, ? 1911 ; cited by Key-Åberg : ? case report.

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FETHKE, J., *Königsb. i. Pr.*, 1897, 8°; cited by Mercier-Bellevue and Hérisset: sequestrum nucleus.

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FLODQUIST, ? 1908; cited by Key-Åberg: cherry stone nucleus.

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GRAHAM, G. W., *Charlotte (N.C.) Med. Jl.*, 1896, viii, 155 ; abstract *J. Laryng., Rhin. and Otol.*, 1896, x, 344 (Hunt) : no nucleus found.

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GUGERSOLL, T. M., ? 1902 ; cited by Key-Åberg : case report.

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GUTHRIE, D., *J. Laryng. and Otol.*, 1926, xli, 454-57 : stone of fifty years' duration in nose.

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HAJEK, M., *Internat. klinik. Rundschau*, 1892, pp. 33-4 ; *ibid.*, pp. 49-52 : large stone ; septal perforation.

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HANDFORD (and WARING, A.), *B.M.J.*, 1893, ii, 117-18 : cherry stone nucleus ; " rhinitis caseosa ".

HANQUET, *Arch. méd. Belges*, 1889, 3s, xxxv, 248-51 ; per *Index-Cat. Surg. Gen.* : cherry stone nucleus.

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HELLOT, R., ? 1902 ; cited by Key-Åberg : ? case report.

HELSMOORTEL, ? 1898 ; cited by Key-Åberg : cherry stone nucleus.

HENDLEY, T. H., *B.M.J.*, 1886, ii, 1161 : weight 720 grains ; nucleus not described.

HENKES, J. C., ? 1909 ; cited by Key-Åberg : prune stone nucleus.

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HESSLER, *Münch. med. Wschr.*, 1892, xxxix, 23 : laminaria nucleus.

HEWETSON, H. B., *J. Laryng. and Otol.*, 1888, ii, 485-86 : 23 years' history ; nucleus, part of tubing from baby's bottle.

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HILL, J. F., *J. Laryng., Rhin. and Otol.*, 1899, xiv, 145-6 : weight 275 grains ; nucleus not described.

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HOPMANN, 70th Meeting Assoc. German Scientists & Physicians, Sect. Laryng. and Rhin., reported in *J. Laryng., Rhin. and Otol.*, 1900, xv, 208-9 : bilateral rhinoliths ; cherry stone nuclei.

HORBYE OF CHRISTIANA, *Int. Zbl. f. Laryng.*, 1896, xii, 372 : case report ; nucleus not described.

HORCASITAS, J., *Rev. Ibero-Am. de Cien Méd., Madrid*, 1915, xxxiii, 257-64 ; per *Index Medicus* : giant rhinolith.

HORIUCHI, H., " Contribution on the origin of rhinoliths," *Dai Nippon Ji-Bi-In-Ko-Kwa-Kwai Kwai Ho, Tokyo*, 1897, iii, 136-49 ; *Index-Cat. Surg. Gen.*

HORN, ? 1788 ; cited by Demarquay and others : " Contribution à l'études des rhinoliths " ; cherry stone nucleus.

HORNE, JOBSON, *Proc. Laryng. Soc., Lond.*, 1905-6, xiii, 6 : in discussion of Watson Williams's case ; case report ; cotton wool nucleus.

HOWARD, R. L., *Ohio M. & S. Jl., Columbus*, 1852-3, v, 215 ; *Index-Cat. Surg. Gen.* : thimble in post-nasal region.

HUNT, J. M., *Glasg. M.J.*, 1887, xxvii, 186-88 : two nasal foreign bodies, a cherry stone and half a damson stone ; *Lpool. med-chir J.*, Jan., 1889, p. 62 ; abstract *Practitioner*, 1889, xlii, 292-3 : rhinolith containing sequestrum.

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IAKONTOW, ? 1924 ; cited by Joulovsky : ? case report.

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IRELAND, J., *Arch. Otolaryng.*, 1929, x, 190-91: ? felt nucleus; 30 × 25 × 15 mm.: weight 5·0 g.

ITO, M., *Taiwan Igakkai Zasshi*, 1935, xxxiv, 1381; per *Index Medicus*: newspaper nucleus.

IVANOFF, V. M., *Vrach. Gaz., St. Peters.*, 1913, xx, 343-5; *Index-Cat. Surg. Gen.*; case report.

JACQUEMART, *Ann. des mal. de l'oreille*, etc., 1884, x, 47-51: fruit stone nucleus.

JANA, A. P., *Indian med. Gaz.*, Sept., 1930, lxv, 504-5: ? blood clot nucleus.

JANATKA, F., *Wien. klin. Rundschau*, 1896, x, 643; résumé by Hérisset: nasopharyngeal rhinolith; bilateral otitis.

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JOUKOVSKY, A., *Ann. d'oto.-laryng.*, 1931, ii, 147-51: four cases; sunflower seed, cherry stone and piece of veneer respectively in three; no nucleus found in fourth; Russian cases reviewed.

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KHAN or KAN, ? 1905; cited by Key-Åberg: prosthetic dental appliance nucleus.

KAHNITY, ? 1902; cited by Oppikofer: antral rhinolith.

KAYSER, R., *Mschr. Ohrenh.*, 1891, xvii, 824-5: incrusted incisor nasal tooth; *ibid.*, 1898, xxxii, 149: two rhinoliths amongst 572 nasal patients.

KEEN, J. A., *J. Laryng. and Otol.*, 1930, xlv, 333-43: incidence of foreign bodies in the nose.

KEĬLIN, M. I., *Prakt. Vrach*, 1903, ii, 1130; *Index-Cat. Surg. Gen.*: "nasal calculi."

KEIPER, G. F., *N.Y. Med. J.*, 1894, lix, 21; per *Index Medicus*: cherry stone nucleus.

KELEMEN, G., *Z. f. Laryng. u. Rhin.*, 1926-27, xv, 93-5: ? blood clot nucleus; good radiograms.

KERN or KERNE, "Douleurs de tête causées pas des calculs"; *Ephem. Nat. Curios.*, 1700, dec. iii, ann. v et vi, obs. 43, p. 100, résumé by Demarquay: ? unilateral multiple calculi; nucleus not described.

Key-Åberg, H., "La Rhinolithase. Monographie et étude de cas"; *Acta Oto-Laryngol.*, 1921-22, iii, 449-472: bibliography extensive but many of the references are not now traced; eleven rhinoliths described; also *Svenska läk-sallsk. handl., Stockh.*, 1921, xlvii, 1-12; cited by Key-Åberg.

KIESSELBACH, ? 1889; cited by Seeligmann and Seifert: no nucleus found.

KISPERT, EL GENIO, ? 1886; cited by Seifert: case report.

KLEIN, W., ? 1906; cited by Key-Åberg: ? case report.

KNIGHT, C. H., *Med. News, Phila.*, 1891, lviii, 6-8: removal of sequestrum from nose; not apparently incrusted.

KOHAN, L. N., *Prakt. Vrach., St. Peters.*, 1908, vii, 528-30; per *Index-Cat. Surg. Gen.*: "nasal calculi."

KÖHLER OF POSEN, ? 1886; cited by Voltolini and Seifert; résumé by Didsbury: two cases, one with wood nucleus.

KÖNIG, ? 1878; cited in an annotation, *B.M.J.*, 1885, ii, 662-4: ? case report.

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KORSAKOW, ? 1927 ; cited by Joukovsky : case report.

KÖSTLIN, *Würt. Kor.-Blatt.*, 1854, xxiv, 51 ; per *Index.-Cat. Surg. Gen.* : grape stone (Voltolini ; Chiari).

KRAUSE or KRUSE, ? 1885 ; cited by Seeligmann ; résumé by Didsbury : cherry stone nucleus.

KRAVCHENKO, F. K., *Zhur. ush. nos. i gorl. bolez.*, 1938, xv, 425-9 ; per *Index Medicus* : case report.

KREBS, G., *Z. f. Ohrenh.*, 1907, lvi, 141-4 : two cases, incrusted baby's bottle teat, and grain of wheat nuclei.

KUHN OF STRASSBURG, *Mschr. f. Ohrenh.*, 1892, xxvi, 189-90 : cherry stone nucleus.

LACOARRET, ? 1904 ; cited by Key-Åberg and Mercier-Bellevue : case 1, graine de citrouille, and case 2, cherry stone nuclei.

LANG, ? 1904 ; cited by Key-Åberg : ? case report.

LANG, *Verhandl. d. Budapest K. Gessell. d. Aerzte*, 1907, Budapest, 1908, 100 ; *Index-Cat. Surg. Gen.* : cherry stone nucleus.

LÁNG, K. VON, *Arch. f. Laryng. u. Rhin.*, 1912, xxvi, 445-50 (pp, 448-9) : bullet in sphenoid sinus ; inverted tooth in antrum and rhinolith 38 × 27 × 15 mm. ; weight 5·8 g. ; nucleus not described.

LANTIN, G., *Arch. f. Laryng. u. Rhin.*, 1896, iv, 137-62 (pp. 143-56) : four case reports ; respective nuclei : fruit stone, paper, and none in two cases ; also per abstract by Trivas, *Rev. hebd. de Laryng.*, 1896, xvi, 1502-04.

LAUFFS, F., *Med. Kor.-Blatt. d. Württ.*, 1897, lxvii, 399 ; *Index-Cat. Surg. Gen.* : four cases, cherry stone nucleus in one.

LAW, E., *Proc. Laryng. Soc., Lond.*, 1896-97, iv, 73 ; in discussion of Hill's case : bead nucleus.

LAZARRAGA, *Gac. méd. de Granada*, 1906, xxiv, 163 ; *Index-Cat. Surg. Gen.* : large rhinolith.

LÉDL, F., *Časop. lék. česk.*, 1932, lxxi, 1262-6 ; per *Index Medicus* : case report.

LÉNART, Z. VON., ? 1908 ; cited by Key-Åberg : glass bead nucleus.

LEVI, W. D., *Kentucky Med. J., Bowling Green*, 1918, xvi, 351 ; *Index-Cat. Surg. Gen.* : case report.

LEYDEN, VON, ? 1894 ; cited by Seifert : cherry stone nucleus.

LINCOLN, W., *Cleveland M.J.*, 1901, vi, 183 ; per *Index-Cat. Surg. Gen.* : large rhinolith.

LIPSCHER, A., ? 1914 ; cited by Key-Åberg : case or specimen demonstration.

LITTLE, T. E., *B.M.J.*, 1891, i, 528 : specimen demonstration.

LOBELL, A., *Laryngoscope*, 1927, xxxvii, 337-40 : case 1, 1 in. × ¾ in. × ½ in. ; nucleus not described ; case 2, nucleus not obtained.

LOCY, F. E., *U.S. Naval Med. Bull.*, 1929, xxvii, 668-9 : ? coal dust nucleus.

LOGAN, P. W., *St. Louis M.S. Jl.*, 1885, xix, 73 ; *Index-Cat. Surg. Gen.* : no nucleus found (Seifert).

LONDON HOSPITAL, *Path. Museum Specimen* ; series lvi, 55 ; cited by de Haviland Hall.

LONGBOTHAM, G., *B.M.J.*, 1903, i, 1372 : cherry stone nucleus.

LÖWENTHAL, S., ? 1894 ; cited by Seifert and Hérisset : ? pea nucleus ; ? mucus nucleus.

LOWNDES, H., *B.M.J.*, 1867, ii, 206 : brass ring, not incrusted ; in posterior nares.

LUBLINSKI, W., *Berl. klin. Wschr.*, 1897, xxxi, 972 : demonstration of three cases ; case 1, small pebble ; case 2, shoe button ; case 3, nucleus not sought.

LUCAS, cited by Seifert : newspaper nucleus.

LUNIN, V. J., ? 1895 ; cited by Seifert and Hérisset : " K kazüistike rinolitov."

LYON, ? 1892 ; cited by Seifert : no nucleus found.

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On Rhinoliths

McALDOWIE, ? 1889 ; abstract *J. Laryng. and Rhin.*, 1890, iv, 122 : demonstration of specimen.

McBRIDE, P., *J. Laryng. Rhin. and Otol.*, 1897, xii, 66 : foreign body nucleus or sequestrum presumed.

MACINTYRE, J., *J. Laryng., Rhin. and Otol.*, 1900, xv, 357 : early radiology in nasal disease.

MACKENZIE, MORELL, " A Manual of Diseases of the Throat and Nose," 1884, vol. ii, 446-7 ; Churchill, Lond. : case 1, unilateral multiple rhinoliths ; case 2, weight 70 grains ; no nucleus found in either case.

M'WHEENY, FALKINER, *Dublin J. Med. Sci.*, 1889, lxxxvii, 165 ; *ibid.*, 444 : early quantitative analysis.

MAJOR, G. W., *Trans. Mont. Med.-Chi. Soc.*, 1890 ; abstract *J. Laryng. and Rhin.*, 1890, iv, 384 (Major) : sea shell nucleus.

MALCONTINE, ? 1896 ; cited by Seifert : no nucleus found.

MALOSSE, *Bull. méd. Algérie*, Feb. 10th, 1897 ; abstract *J. Laryng., Rhin. and Otol.*, 1897, xii, 698 (Cartaz) : case report.

MALYUTIN, E. N., *Med. obozr. Mosk.*, 1896, xlv, 418-22 ; *ibid.*, 1898, l, 334-7 ; per *Index Medicus* and *Index-Cat. Surg. Gen.* : case report of girl aged 12 years.

MARCHAL, *Gaz. méd. de Picardie, Amiens*, 1897, xv, 257-62 ; résumé by Hérisset : weight 1·86 gm. ; no nucleus found.

MARSH, F., *J. Laryng., Rhin. and Otol.*, 1897, xii, 189 : mother o'pearl button nucleus.

MASCAREL, J., *Bull. Soc. de Chir, Paris*, 1852, ii, 322-26 : bone, ? sequestrum, nucleus ; " rhinitis caseosa ".

MASINI, G., *Gaz. d. Ospitali, Milano.* 1888, ix, 426 ; *Index-Cat. Surg. Gen.* : cherry stone nucleus (Hérisset).

MAURER, ? 1889 ; cited by Seeligmann : ? case report.

MEDAN, SUÑE Y, ? 1921 ; cited by Key-Åberg : case 1, prune stone nucleus ; case 2, coque de pignon nucleus.

MELZI, U., *Arch. ital. di otol.*, 1906, xvii, 312-17 : case 1, cherry stone nucleus ; case 2, no nucleus found ; quantitative analyses.

MERCIER-BELLEVUE OF POITIERS, *Rev. hebd. de laryngol.*, 1909, ii, 138-41 : no nucleus found ; probably " primary ".

MESZ, ? 1913 ; cited by Key-Åberg : ? case report.

MEYER, F., *Arch. f. Laryng. u. Rhin.*, 1899, ix, 64-9 : metal button nucleus.

MEYERSON, S., *Medycyna Warszawa*, 1884, xii, 712-14 ; *Index-Cat. Surg. Gen.* : foreign body in the nose of a child ; ? ? rhinolith.

MEYERSON OR MEYERSOHN, ? 1893 ; cited by Seifert and Seeligmann : no nucleus found.

MILLER, L. H., *Brooklyn M.J.*, 1900, xiv, 398 and 400-01 : cherry stone nucleus (wrongly credited to Braislin by Hérisset).

MILLIGAN, W., *Med. Chron.*, 1896, v, 182-3 ; no nucleus described ; *J. Laryng. and Otol.*, 1898, xiii, 284 ; nasopharyngeal foreign body.

MINK, P. J., *Nederl. Tijdschr. Geneesk.*, 1912, i, 1061-3 ; *Index-Cat. Surg. Gen.* : case 1, cherry stone nucleus ; case 2, cotton wool nucleus (Key-Åberg).

MINKIEWCZ, ? 1885 ; résumé by Key-Åberg : cherry stone nucleus.

MIOT, C., *Rev. hebd. de laryng.*, etc., Paris, 1898, xix, 1127-36 : nucleus ; bout de sonde, incrusted ; quantitative analysis.

MITTER, K. K., *Indian med. Gaz.*, 1873, viii, 156; *Index-Cat. Surg. Gen.* : case report.

MOELLER, J., *Arch. internat. de laryng., Paris*, 1909, xxvii, 785-88; *Index-Cat. Surg. Gen.*: "quelques cas de rhinolithes et un cas d'otolithase"; iron oxide, 36% in one rhinolith ; translation by Menier.

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Cyril John Polson

MOLINIÉ, J., " Les corps étranger du nez chez les enfants " ; *Méd. Mod., Paris,* 1898, ix, 633 ; per *Index Medicus.*

MONNIÉ, E.-J., *Thèse de Bordeaux,* 1889, 4° : résumé of his two cases by Didsbury ; no exogenous nuclei found ; ? blood clot in one.

MONTAGUE, A. J. H., and LAKE, R., *Lancet,* 1903, i, 1165 : cherry stone nucleus.

MOORE, IRWIN, *J. Laryng., Rhin. and Otol.,* 1917, xxxii, 101-2 ; *ibid.,* 386-92 : foreign body in antrum for 25 years ; not incrusted.

MORELLI, K., *Orvosi hetil. Budapest,* 1886, xxx, 1513-18 ; *ibid.,* 1896, xi, 541 ; per *Index-Cat. Surg. Gen.* : ? two, or three, cases ; one with cherry stone nucleus (Seifert).

MORIARTY, M. D., *B.M.J.,* 1886, i, 690 : nucleus not found ; weight 2 drachms ; " rhinitis caseosa ".

MORWITZ, S. M., *Arch. oto-laryng.,* 1934, xx, 704-7 : weight 10·4 g. ; nucleus not described.

MOUNIER OF PARIS, *Bull. Soc. franç. d'otol.,* etc., 1898, xiv, 382-4 : lachrymal duct calculus ; cannula nucleus.

MOURE, E. J., *Rev. de laryng.,* 1894, xiv, 87-98 : case 1, classical " primary " rhinolith ; ? blood clot nucleus ; case 2, graine d'orange ou de citron nucleus ; rhinitis caseosa ; case 3, morceau de bouchon nucleus ; also *Mschr. f. Ohrenh.,* 1893, xxvii, 219-222 ; 257-61 (cases 1 and 2) ; also *Rev. mens. de laryng. et rhin.,* 1882, cited by Moure (case 2) ; also *Gaz. hebd. d. Sc. méd. de Bordeaux,* 1893, xiv, 376-88 ; résumé by Hérisset (case 1 again); also *Mschr. f. Ohrenh.,* 1895, xxix, 343 : on the necessity for histological and chemical examination of rhinoliths.

MÜHLENKAMP, *Münch. med. Wschr.,* 1909, xxv, 1282 : two cases of intra-nasal bodies, not incrusted.

MYERSON, M. C., *Laryngoscope,* 1928, xxxviii, 393-5 : weight 56 g.

NAVRATIL, D. VON, *Pest. Med.-Chir. Presse, Budapest,* 1908, xliv, 932 ; *Index-Cat. Surg. Gen.* : case report.

NEMAI, J., *Fűleszet, Budapest,* 1910, 1-4 ; per *Index Medicus* ; ? *Orvosi hetil.,* 1910, xlvii (Key-Åberg) : caroub nut nucleus.

NITSCHE, *Mschr. f. Ohrenh.,* 1891, xxv, 196-7 : bilateral rhinoliths : cherry stone nuclei.

NOLTE, *Allg. med. cent.-zeit., Berl.,* 1887, lvi, 1181 ; per *Index Medicus* : large rhinolith ; qualitative analysis by Eharius.

NOQUET OF LILLE, *Bull. méd. du Nord.,* 1887 ; cited by Noquet, 1894 : boot button nucleus ; *Rev. de Laryng., Paris,* 1894, xiv, 623-8 : cherry stone or boot button nucleus ; *ibid.,* 1890, July 1st, 425 (Seeligmann) : ? third case ; black silk nucleus ; cited by Noquet as 1890.

NOURSE, W. E. C., *B.M.J.,* 1883, ii, 728 : weight 46 grains, 1 in. × $\frac{8}{10}$ in. × $\frac{6}{10}$ in. ; bone nucleus.

NOWOTNY, E., *Przegl. Lek., Krakow,* 1904, xliii, 681, 697 ; *Index-Cat. Surg. Gen.* : " Foreign Bodies of the Nose, Pharynx & Oesophagus, extracted after being present for two years " ; ? any case report of rhinolith ; included by Key-Åberg.

OMATSKI, V. I., *Protok. i trudi Obsh., Archangel vrach* (1896), 1897, 26-32 ; *Index-Cat. Surg. Gen.* : case report.

ÓNODI, A., " Lachrymal stone in nasal cavity " ; *Orvosi hetil., Budapest,* 1901, xlv, 481 ; *Index-Cat. Surg. Gen.*

OPPIKOFER, E., *Arch. f. Laryng. u. Rhin., Berl.,* 1908, xx, 31-7 : antral rhinolith ; qualitative analysis ; review of literature ; also ? 1911 ; cited by Key-Åberg : nasal stone ; cherry stone nucleus.

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OSTINO, G., *Giorn. d. R-Accad. di Med., Torino*, 1898, 4s, xlvi, 215; per *Index Medicus*: case report.

OTTO, ? 1891; cited by Seifert; "Z. Casuist. d. Steinbild. in d. Nase": ? if any case reported.

PANT, H. D., *Indian med. Rec.*, 1898, xiv, 188; per *Index Medicus*: large rhinolith causing nasal deformity.

PARKER, R., *Lancet*, 1885, i, 378: gun-breech and bolt in nose; not incrusted.

PARKER, W. W., *N.Y. Med. J.*, 1890, li, 75: incrusted piece of wood.

PATERSON, D. R., *J. Laryng., Rhin. and Otol.*, 1899, xiv, 252-3: nasopharyngeal rhinolith; part of feeding bottle nucleus.

PELÁEZ, P. L., *Gac. méd. di Granada*, 1897, xv, 528-31; per *Index Medicus*: case report.

PERESWETON, ? 1882; résumé by Didsbury; noix de cédre nucleus.

PHILLIPS and CUNIER, *Arch. de méd. belge* (*Brux.*), 1842, ix, 389-90: lachrymal calculus.

PINGAULT, *Gaz. des Hôp.*, 1852, cxlv. 578-9; also *Bull. Soc. de méd. de Poictiers*, 1852, xx, 74-6; per *Index-Cat. Surg. Gen.*: cherry stone nucleus.

PISANO, G., *Arch. internat. de laryng.*, 1907, xxiv, 150-6: pepin de poire nucleus.

PLATER, *De olfactus lesione*, 1736, lib. 1, c.9, p. 264; theory of inspissated mucous nucleus; no new case reported (Hérisset); case report, blood clot nucleus (Seifert).

POHL OF SALZBRUNN, *Berl. klin. Wschr.*, 1893, xxx, 586: cherry stone nucleus.

POLISAR, J. M., *Laryngoscope*, 1933, xliii, 658-63: case 1, weight 53 gr., 25·4 × 19·5 × 19·5 mm.; Indian nutshell nucleus; case 2, weight 45 gr., 19·5 × 13·1 × 6·5 mm.; nucleus not described; case 3, weight 68 gr., 39·8 × 25·4 × 12 mm.; nucleus not described.

POLO OF NANTES, *Gaz. méd. de Nantes*, 1895-96, xiv, 77; also *Rev. hebd. de laryng.*, 1896, xvi, 964-6; also abstract *J. Laryng., Rhin. and Otol.*, 1896, xi, 147 (Joal): cherry stone nucleus; quantitative analysis.

POLSON, C. J., *J. Laryng. and Otol.*, 1942, lvii, 160-77: on "Rhinitis Caseosa".

POLYÁK, L., *Orvosi hetil., Budapest*, 1900, xliv, 828; per *Index-Cat. Surg. Gen.*: "cases of rhinoliths."

POOLE, W. H., *N.Y. Med. J.*, 1898, lxviii, 45-6; abstract *J. Laryng, and Otol.*, 1898, xiii, 564: no nucleus found; also in Louisville *M. Month.*, 1898-9, v, 297, and in *Nashville J.M. & S.*, 1898, xxxiv, 161-4 (Hérisset).

POPOFF, V. A., *Trudi i Protok. Imp. Kavkazsk. Med. Obsh., Tiflis*, 1907-8, xliv, 445-7; *Index-Cat. Surg. Gen.*: incrusted nasal tooth.

PORST, E., ? 1907; cited by Key-Åberg: nut nucleus.

POWER, D'ARCY, *Trans. Path. Soc., Lond.*, 1886-87, xxxviii, 321: weight 33 gr., piece of rag as nucleus.

PREOBRAZHENSKI, S. S., *Wratsch. Gaz.*, 1904, xi, 4, 43; *Index-Cat. Surg. Gen.*: "Nine cases of foreign bodies and rhinoliths."

PRESENCIA, G., and UCELAY, A. BOSCH, *Archivos latinos d. rhin.-laring. Otol., Barc.*, Aug., 1904; per *Index Medicus* and *Index-Cat. Surg. Gen.*; abstract *Ann. des mal. de l'oreille*, etc., 1906, xxxii, 91-2 (Mossé; authors names given as Presencia and Melay): weight 85 grammes; nucleus not described.

PRICE-BROWN, ? ? 1892; cited by Seifert: no nucleus found.

PRICHARD, A. W., *Trans. Bristol Med.-Chi. Soc.*, 1878, i, 101; *Index-Cat. Surg. Gen.*: case report.

PRINGLE, ? 1887; cited by Seifert: nasal foreign body.

PUCHKOVSKI, A., *Vrach. Gaz., St. Peters.*, 1908, xv, 830-51; *Index-Cat. Surg. Gen.*: "Zur Kasuistik der Rhinolithen."

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PUSATERI, S., *Arch. ital. di otol.*, 1904-5, xvi, 295-300 ; case report.

RABBONI, I., " Contrib. allo studio dei rinolite " ; *Gaz. sicil. di med. e chir., Palermo*, 1907, vi, 113, 145 ; *Index-Cat. Surg. Gen.*

REBATTU, *Lyon méd.*, 1925, cxxxv, 496-7 : no nucleus found ; quantitative analysis.

REINTJES, ? 1892 ; cited by Seifert : no nucleus found.

RENAUD OF NANCY, *Rev. de laryng., Paris*, 1895, xv, 966-8 : case 1, boot button ; case 2 : cherry stone nucleus.

RENDU, R., *Lyon méd.*, 1912, cxix, 474-5 : annular rhinolith.

REVERDIN, J. ; cited by Potiquet ; *Gaz. des Hôp.*, 1889, lxii, 121-9 : unilateral multiple stones ; " rhinitis caseosa ".

RÉVÉSZ, E., ? 1914 ; cited by Key-Åberg : fruit stone nucleus.

REYNOLDS, J. O., *Laryngoscope*, 1908, xviii, 215 : foreign body in maxillary antrum ; not incrusted.

DE REZENDE, M. O., " Sobre un interessante casode rhinolithe," *Brazil Med., Rio de Jan.*, 1919, xxxiii, 324 ; *Index Medicus.*

RIEDLINUS, V. or REIDLINUS, *Ephem. Nat. Curios*, 1706, dec. iii. ann. IX & X ; Obs. 145, p. 268 ; abstract by Demarquay : unilateral multiple calculi.

RINDFLEISCH, ? 1887 ; cited by Hérisset : ? case report.

RIPAULT, H., *Ann. des mal. de l'oreille*, etc., 1895, xxi, 520 : cherry stone nucleus.

RITTER, C., *Memorabilen, Heilbr.*, 1876, xxi, 311 ; cited by Seeligmann, Hérisset and Chiari : cherry stone nucleus.

ROAULT, A., *Rev. Méd. de l'est., Nancy*, 1898, xxx, 129-47 ; abstract *J. Laryng. and Otol.*, 1898, xiii, 564 : cherry stone nucleus.

ROE, J. C., *Arch. Laryng., N.Y.*, 1880, i, No. 2, 149-54 ; cited by Morell Mackenzie, Seeligmann, Hérisset and Chiari : pledget of cotton wool nucleus.

ROHRER OF ZURICH, *Wien. klin. Wschr.*, 1890, No. 2, 27 ; weight 2·29 g., 20 × 17 × 13 mm. ; *ibid.*, 1892, No. 5, 85 : weight 0·71 gm. ; nucleus not described.

DE ROSA, M., *Arch. ital. di otol.*, etc., 1901, xi, 133-42 : case 2, rhinolith complicated by " rhinitis caseosa ".

ROTHENAICHER OF PASSAU, *Mschr. f. Ohrenh.*, 1897, xxxi, 65-6 : cherry stone nucleus.

ROUYER (NÉLATON), *Bull. de la Soc. Anat. de Paris*, 1857, xxxii, 51 ; résumé by Didsbury : nucleus not described ; *ibid.*, 1858, xxxiii, 3 ; *Index-Cat. Surg. Gen.*

RUAULT, A., *Rev. de Laryng.*, 1890, x, 530-33 ; discussion 534 : case 1, snuff taker ; case 2, nucleus not described ; case 3, cherry stone nucleus ; for quantitative analysis *see* Berlioz.

RUEDA, F., ? 1899 ; cited by Key-Åberg : ? case report.

RUNGE OF HAMBURG, *Zbl. Hals.-Nase-u. Ohrenh.*, 1931-32, xvii, 254 : weight 6·65 g. ; ? fruit stone nucleus.

RUSS, ? 1904 ; cited by Key-Åberg : cherry stone nucleus.

RUTTIN, ? 1907 ; cited by Key-Åberg : apricot stone nucleus.

RUYSCH, *Obs. Anat. Amstelodami*, 1733, Obs. 44, p. 42 ; abstract by Demarquay.

SABRAZÈS, *see* Moure, 1894 : histology of a rhinolith.

SACHER, A., ? 1903 ; cited by Key-Åberg : ? case report.

SALZBERGER, M., *Mschr. f. Ohrenh.*, 1928, lxii, 1377-8 : nucleus not described.

SANDEL, A. L., 1892 ; cited by de Haviland Hall : case report.

SANDFORD, ? 1895 ; cited by Seifert : ? case report.

SÄNGER, ? 1897 ; cited by Seifert : cherry stone nucleus.

DE SANTI, *Proc. Laryng. Soc., Lond.*, 1905-06, xiii, 16, in discussion of Watson's case : cherry stone nucleus.

SAVIALLES, *Bull. de la Fac. Méd.*, 1814-15, iv, 411 ; *Index-Cat. Surg. Gen.* : cherry stone nucleus (Demarquay).

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SCHÄFER, ? 1900 ; cited by Seifert as a foreign body not incrusted.

SCHÄFFER, cited by Seifert as a cherry stone nucleus ; ? second case of bead in the nose.

SCHAPRINGER, ? 1889 ; cited by Seeligmann : ? case report.

SCHECH, cited by Siefert : " glaspapier " nucleus.

SCHEIER, " Ueber die Verwerthing der Rüngenstrahlen in der Rhino. u. Laryngologie," *Arch. f. Laryng.*, 1897, vi, 57-66.

SCHEPPEGRELL, W., *Rev. internat. de Rhinol*, etc., Paris, 1896, vi, 175-77 : ? blood clot nucleus (Hérisset).

SCHIFFERS, F., Soc. méd. chir. de Liége, Meeting Oct. 1, 1891 ; abstract *J. Laryng. Rhin. and Otol.*, 1892, vi, 15 (Hicquet) : nucleus not described.

SCHLESINGER, ? 1888 ; cited by Voltolini : " tischglocke " nucleus.

SCHMALOWSKI, R., *Königsberg i Pr.*, 1897, 8° ; *Index-Cat. Surg. Gen.* : two case reports.

SCHMIDT, C., ? 1905 ; cited by Key-Åberg : cherry stone nucleus, but Seifert cites it as wool tampon nucleus.

SCHMIDT, ? 1886 ; cited by Voltolini : " kreuzdornstück " nucleus.

SCHMIEGELOW, E., *Nord. med. Ark., Stockh.*, 1884, xvi, 1-10 ; per *Index Medicus* ; also *Rev. mens. de laryng.*, 1st Nov., 1884, v. 380-83, and abstract by Didsbury; also in Annotation, *B.M.J.*, 1885, ii, 662-3, and in *Rev. Sci. Med.*, 1885, xxv, 330-1 : no nucleus found ; ? 1906, cited by Key-Åberg : ? new report.

SCHOETZ, ? 1899 ; cited by Key-Åberg : cherry stone nucleus.

SCHOLTZ, ? 1887 ; cited by Seeligmann ; ? Schoetz : ? case report.

SCHUSTER, *Z. d. nordd. Chir. Ver. Magdeb.*, 1847, i, 339-48 ; *Index-Cat. Surg. Gen.* : lachrymal calculus.

SCOTT, *Texas State J. Med.*, 1906-07, ii, 267 ; *Index Medicus* : weight 43 grains (Bailey).

SEELIGMANN, M., *Inaug. Dissert., Heidelb.*, 1892 : case, 1 metal splinter nucleus ; iron content 37·3% ; case 2, newspaper nucleus ; bibl. of over 100 refs.

SEIFERT, O., ? 1888 ; cited by Voltolini ; metal button nucleus ; *Rev. de laryng*, etc., 1895, xv, 1021-24 ; *Index-Cat. Surg. Gen.* : incrusted tooth ; also " Die Nase ", in Paul Heymann's *Handbuch der Laryng. u. Rhin*, A. Hölder, *Wien.*, 1900, Band iii, heft i, pp. 550-77 : over 300 refs. but several are not now traced ; some probably relate to nasal foreign bodies, not incrusted.

SEILER, C., *Trans. Path. Soc. Phila.*, 1885-7, xiii, 125-7 ; *Index-Cat. Surg. Gen.* : two large rhinoliths.

SEWELL, D. L., *Lancet*, 1909, ii, 712 : metal ring nucleus ; cited by Key-Åberg as " Sevrill ".

SHIMADA, S., *Iji Kwai Ho Ogatu*, etc., *Osaka*, 1899, 3-36 ; *Index-Cat. Surg. Gen.* : case report.

SIEBERT, J. H., cited by Key-Åberg : " morceau de palmier " nucleus.

SIKKEL, A., *Mschr. f. Ohrenh.*, 1896, xxx, 69 : case 1, cherry stone nucleus ; case 2, no nucleus found.

SILITCH, V., *St. Petersb.*, 1888, 8° ; also *Vratch*, 1887, No. 1, 16 ; also *Moskva*, 1890, 120 ; *Index-Cat. Surg. Gen.* ; also abstract *B.M.J.*, 1887, i, 467 : two cases, sequestrum or bone nucleus in one.

SIMKÓ, L., *Sebeszet, Budapest*, 1912, 17 ; *Index-Cat. Surg. Gen.* : " Nasal calculi."

DE SIMONI, A., " Contribution à la connaissance de la flore bactérienne des calculs de nez " ; *Arch. int. de laryng.*, 1907, xxiii, 182-8.

SMITH, LAPTON, ? 1888 ; résumé by Didsbury : boot button nucleus.

SMITH, L. W., *Laryngoscope*, 1922, xxxii, 444-46 : case 2, rhinolith in cement worker.

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SMITH, T., *B.M.J.*, 1867, ii, 547 : germinating bean in nose ; not a rhinolith.

SNIEZHKOFF, V. P., *Terap. Obozr., Odessa*, 1914, vii, 414-20; *Index-Cat. Surg. Gen.* : case report.

SNYDER, J., and FELDMAN, M., *Ann. Otolaryng.*, 1936, xlv., 430-5 : case 1, gauze sponge nucleus ; case 2, shoe button ; case 3, knitted twine.

SOKOLOW, T. P., *Yez hemies Ushn. Gorlov. i. Nosov. Boliez., St. Petersb.*, 1912, vii, 467 ; *Index-Cat. Surg. Gen.* : cherry stone nucleus (Key-Åberg).

SOKOLOWSKI, K., *Medycyna, Warsaw*, 1907, xxxv, 532, 555 ; *Index-Cat. Surg. Gen.* : pumpkin skin nucleus (Key-Åberg).

SPICER, S., *Proc. Laryng. Soc., Lond.*, 1895-96, iii, 73-4 : on the detection of intranasal foreign bodies.

STAMM, J., ? 1916 ; cited by Key-Åberg : ? case report.

STEPANOFF, ? 1898 ; cited by Key-Åberg : ? case report.

STOCKTON, ? 1884 ; cited by Chiari : small pebble nucleus.

STOERK, ? *1875* ; cited by Czarda : *no nucleus described ; only case in this surgeon's* vast experience.

STOKER, G., *Trans. Path. Soc., Lond.*, 1886, xxxvii, 449 : ? blood clot nucleus.

STUCKY, J. A., *Laryngoscope*, 1896, i, 102, per *Index Medicus* : weight 76 grains, in child aged 10 years.

SUPRUNOFF, V. K., *Kub. nauch.-med.-vestnik.*, 1930, xii-xiii, 133-37 ; per *Index Medicus* : case report.

SYMONDS, C., *Proc. Laryng. Soc., Lond.*, 1899-1900, vii, 29-30 : nucleus of rose leaves.

TANNER, T. H., " Practice of Medicine," 1869, H. Renshaw, Lond., VIth edition, vol. i, p. 516 : shell nucleus.

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TAYLOR, F. W., *B.M.J.*, 1905, ii, 329 : bead nucleus.

TESSIER, L. J., *L'Union Méd. du Canada*, 1936, lxv, 658-9 : case 1, no nucleus found ; case 2, patient kept the specimen.

THOST., *Deut. med. Wschr.*, 1904, xxx, 1365 : cherry stone nucleus.

THOURET, *Arch. gén. de méd.*, 1829, xix, 27 ; résumé by Demarquay : no nucleus described.

TILLAUX, ? 1876 ; résumé by Didsbury : cherry stone nucleus.

TODD, C. A., ? 1885 ; cited by Seeligmann : ? two case reports.

TORMENE, E., *Boll. d. mall. dell'or*, etc., 1911, xxix, 97-105 : epileptiform convulsions due to rhinolith ; nucleus ? un piccolo seme di fagiolo.

TRAUTMANN, G., *Z. Hals.-Nasen-u. Ohrenh.*, 1922, i, 239-40 : nucleus not described.

TRIMARCHI, A., *Boll. d. mal. dell'or*, etc., 1921, xxxix, 129-32 : plum stone nucleus.

TRUKENBROD, *Mschr. f. Ohrenh.*, 1889, xxiii, 139 : boot button nucleus.

TSUGAWA, S., *Oto.-rhino.-laryng.*, 1937, x, 725: weight 2·8 gm., "wättestuckchen" nucleus, 25 × 16 × 11 mm. ; per abstract by Yasumasa.

UCELAY, ? date ; cited by Key-Åberg : olive stone nucleus.

UNIVERSITY COLLEGE HOSPITAL, Museum specimen 1383c ; *ibid.*, 1383d ; cited by de Haviland Hall.

VERNEUIL, *Gaz. des Hôp.*, 1859, xxxii, 252: unilateral multiple stones; ? "pepin de raisin" nucleus.

VOLTOLINI, R., " Die Krankh. der Nase " ; 1888, Breslau, E. Morgenstern : no exogenous nucleus found.

VOORHEES, I. W., *J.A.M.A.*, 1920, lxxiv, 672 ; iron bolt in ethmoid sinuses.

WAGNER, R., 1891 ; abstract *J. Laryng., Rhin. and Otol.*, 1892, vi, 73 (Michael) : nucleus not mentioned ; ? blood clot (Seifert).

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On Rhinoliths

WAKEFIELD, W. H., *Charlotte (N.C.) M.J.*, 1894, iv, No. 2, 36-8 ; *Index-Cat. Surg. Gen.* : case report.

WARING, A., 1893 ; *see* Handford, whose patient Waring described.

WEIL, ? 1880 ; cited by Czarda, Hérisset and Seeligmann ; ? coffee bean nucleus (Czarda), ? " tuchstückchen " nucleus (Chiari).

WEILL, G. A., *Oto.-rhin.-laryng., Internat.*, 1937, xxi, 69-70 ; per *Index Medicus* : bullet 30 years in antrum.

WEISMANN, ? 1892 ; cited by Seifert : cherry stone nucleus, present for 60 years (Key-Åberg).

WEISS, *B.M.J.*, 1887, i, 882 : exhibition of a rhinolith.

WEPFER, 1727 ; résumé by Demarquay : incrusted tooth.

WERTEPROW, ? 1895 ; cited by Seifert : no nucleus found.

WESSING or WESSINGER, ? 1891 ; cited by Seeligmann and Seifert : no nucleus found.

WEST, J. F., *Lancet*, 1872, i, 147 : pebble nucleus ; weight 20 grains ; $\frac{1}{2}$ in. × $\frac{1}{4}$ in., not 1 in. as sometimes cited.

WHITE, J. A., *Virgin. Med. Monthly*, 1890-91, xvii, 438-440 ; per *Index Medicus* : case report.

WILLIAM, ? 1898 ; cited by de Simoni : ? case report.

WILLIAMS, WATSON, *Proc. Laryng. Soc., Lond.*, 1905-06, xiii, 16 : cotton wool nucleus ; discussion pp. 16-17 (Baber, de Santi and Jobson Horne, who related their cases).

WINGRAVE, WYATT, *J. Laryng. and Otol.*, 1894, viii, 814 : no nucleus found.

WRIGHT, A. J., *J. Laryng. and Otol.*, 1927, xlii, 192-3 : antral rhinolith ; molar tooth nucleus ; sinusitis.

WRIGHT, JOHNATHAN, *N.Y. Med. Record*, 1889, xxxvi, 396-7 : case 1, sponge nucleus ; case 2, piece of tooth as nucleus ; case 3, incrusted tooth.

YUSTIN, K. A., *Russk. oto-laring.*, 1931, xxiv, 398-400 ; per *Index Medicus* : case report.

ZAKHER, A. V., *Vracht. Gaz., St. Petersb.*, 1903, x, 331, 349 ; cited by Hérisset : " Nasal calculi."

ZAKKHEYEFF, V. M., *Khirurgia, Mosk.*, 1899, vi, 3-5 ; *Index-Cat. Surg. Gen.* : large rhinolith.

ZIMM, A. M., *Sibirsk Vrach., Tomsk.*, 1913-14, i, 74-7 ; per *Index Medicus* : " Formation of rhinoliths."

ZUCKERKANDL, E., " Normale und Pathologische Anatomie der Nasenhöhle und ihrer pneumatischen Anhänge " ; W. Braumüller, *Wien und Leipzig*, 1892, vol. 2, pp. 158-62 ; also in " Anat. Norm. et Path. des Fosses Nasales et de leur anexes pneumatiques " ; Lichtwitz and Garnault's translation, 1894, i, pp. 555-8 and 578-80 : case 1, cherry stone nucleus ; case 2, rhinolith 50 × 25 mm. ; no nucleus described and case 3, antral rhinolith size of a nut. *See* plate 18, figs. 1-6 for case 2.

ZWILLINGER, H., ? 1896, cited by Seifert : ? case report.

Except a few early cases, the primary reference is omitted, unless it has been verified.

https://doi.org/10.1017/S0022215100011002 Published online by Cambridge University Press

Cyril John Polson

Since this paper was submitted for publication, information concerning rhinoliths removed by Mr. Stirk Adams and Mr. Pavey-Smith has been received, and I am indebted to their kindness for permission to give some details of their cases, and to Mr. Pavey-Smith for an opportunity to examine his specimen.

Mr. Pavey-Smith's Case.

This rhinolith was removed from a boy aged 16, who, when aged 8, sustained an injury to his nose in a motor accident. Apparently there was then epistaxis, for which the nose was packed by gauze. When seen by Mr. Pavey-Smith, he complained of septal deviation and, during submucous resection to correct it, a rhinolith was discovered in the posterior half of the left nasal fossa. It was removed in one piece and measures 33 × 18½ × 5 mm. One aspect, presumably septal, is relatively flat, but elsewhere the surface is distinctly irregular. It is of light brown colour and fairly hard consistence. Mr. Pavey-Smith cut an oval window in the specimen to display the small piece of blood-stained gauze, which forms the nucleus. (The specimen is preserved in Mr. Pavey-Smith's collection of foreign bodies.)

Mr. Stirk Adams's Cases.

(*a*) The patient was a woman aged 31, who had had nasal trouble for only one month. A large rhinolith, approximately 1½″ × ¾″ × 1″, was removed piecemeal from the right nasal passage. No nucleus was found. Much pultaceous (" caseous ") material lay behind the rhinolith. Biopsy of mucosa from the mid-turbinal region showed that it was involved by a distinctly active, chronic inflammatory process, with hyperplasia and some squamous metaplasia of the respiratory epithelium.

(*b*) A rhinolith of approximately similar size was also removed from another patient, and no foreign body nucleus was found when the rhinolith was broken up. " Rhinitis caseosa " was absent in this patient.

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