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# The major intrinsic pancreatic ducts of the rhinoceros

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(With 1 plate and 4 figures in the text)

A first-time account is given of the parenchymal subdivisions and related duct system of the pancreas in *Didermocerus, Diceros* and *Ceratotherium*. In each of these rhinoceros forms a small, superficial portion only of the caput pancreatis is drained by a Santorini duct opening directly into the duodenum. The remainder of the pancreatic parenchyma is drained principally by a transverse and an ascending duct, from whose union arises a short Wirsung duct which enters the duodenum through an intermediary Vaterian ampulla situated within a prominent papilla duodeni.

## Contents



## Introduction

Recorded information concerning the rhinoceros pancreatic duct system consists of observations made on two animals only, namely, an adult male Indian rhinoceros (*Rhinoceros unicornis*) dissected by Owen (1852) and an adult female Sumatran rhinoceros *(Didermocerus sumatrensis)* dissected by Garrod (1873). The pancreas of each of these specimens was described as comprising a major pars splenica (the descriptive cervix, corpus and cauda pancreatis) and a minor pars duodenalis (descriptive caput pancreatis) and as being drained by two terminal ducts, a major Wirsung duct and a minor Santorini duct. These ducts opened into the pars descendens duodeni equidistantly from the pylorus, the former through an intermediary Vaterian ampulla, the latter separately and directly. The Wirsung duct was held to drain the pars splenica pancreatis only, the Santorini duct the pars duodenalis pancreatis.

This inference, however, is shown to be unwarranted by recent investigation of the intraglandular disposition of the principal pancreatic ducts in *Didermocerus, Diceros* and *Ceratotherium*. For in these forms the pars duodenalis pancreatis is imperfectly subdivided into unequal deep and superficial portions, each of which (like the pars splenica pancreatis) is provided with a principal duct. The Santorini duct proves to be the excretory channel of the superficial portion only of the pars duodenalis and the Wirsung duct to be the product of ducts draining, respectively, the deep portion of the pars duodenalis and the whole of the pars splenica.



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## Historical

The earliest recorded observations on the rhinoceros pancreatic duct system were made by Felix Vicq-d'Azyr in Paris (1793) during his anatomization of the much decomposed carcass of the male Indian rhinoceros which had lived in the Royal Menagerie at Versailles from 1770 to 1793. Towards a proposed monograph on this animal's splanchnology Vicq-d'Azyr made manuscript observations and commissioned 38 anatomical plates by N. Maréchal, P. J. Redouté and H. J. Redouté. Publication of the monograph was seemingly prevented, however, by his untimely death (June 20, 1794), but the materials assembled for the purpose are fortunately preserved in the Bibliothèque Centrale of the Muséum National, Paris.

Among these, plates 30 and 44 (by P. J. Redouté) illustrate a pancreas largely reduced by post-mortem change to parenchymal remnants surrounding a Wirsung duct and devoid of a pre-existent papilla duodeni and Vaterian ampulla. The Wirsung duct is depicted as an opened (and unduly large-bored) channel displaying in its wall the minute ostia of tributary ducts and as terminating in a conical distal extremity which traverses the duodenal wall contiguously to the conical distal end of the choledochus. No Santorini duct is illustrated and the poor state of tissue-preservation clearly precluded any recognition of a topographical subdivision of the pars duodenalis.

Owen (1852) gave the only published account to date of the general splanchnology of the Indian rhinoceros and subsequently (Owen, 1868) amplified certain of his observations thereon. His subject was an adult male animal, the first example of its kind to be acquired by the Zoological Society of London, in whose menagerie it lived from 1834 to 1849. The pancreas was described as comprising a large pars splenica and a much smaller pars duodenalis and as being terminally drained by a major (Wirsung) and a minor (Santorini) duct. The Wirsung duct pierced the duodenal wall dorso-medially accompanied by, but independent of, the distal end of the biliary duct and both these channels opened separately into the fundus of a Vaterian ampulla. This last lay within a prominent papilla duodeni with its ostium at the apex thereof. The Santorini duct pierced the duodenum ventro-medially to open into the duodenal lumen by a discrete and inconspicuous ostium. The Wirsung duct was specifically designated 'the duct of the splenic portion' [of the pancreas] and the Santorini duct 'the duct of the smaller portion', thereby expressing Owen's opinion that the Wirsung duct drained no part of the pars duodenalis pancreatis and that this portion was drained wholly and exclusively by the Santorini duct (Fig. 1a).

Garrod (1873) provided the classic account of the splanchnology of the Sumatran rhinoceros (*Didermocerus sumatrensis*) from his dissection of an old female animal in the menagerie of the Zoological Society of London but devoted scant attention to the pancreas. The organ was dismissed as being 'irregular, not large or concentrated' and no mention was made of any subdivision of its pars duodenalis or of the disposition of the principal intraglandular pancreatic ducts. A major terminal (Wirsung) duct was observed to open alongside the distal end of the choledochus, into the fundus of a Vaterian ampulla enclosed within a prominent papilla duodeni and a minor (Santorini) duct to open separately and directly into the duodenum.

By implication, at least, Garrod followed Owen in allocating drainage of the pars splenica to the Wirsung duct and that of the entire pars duodenalis pancreatis to the Santorini duct (Fig. 1a).

The pancreatic duct system of the Javan rhinoceros (*Rhinoceros sondaicus*) is unrecorded and likely to remain so; that of the white rinoceros (*Ceratotherium simum*) and the black rhinoceros (*Diceros bicornis*) has been hitherto unexplored.

Present examination of this system in *Didermocerus, Ceratotherium* and *Diceros* material shows

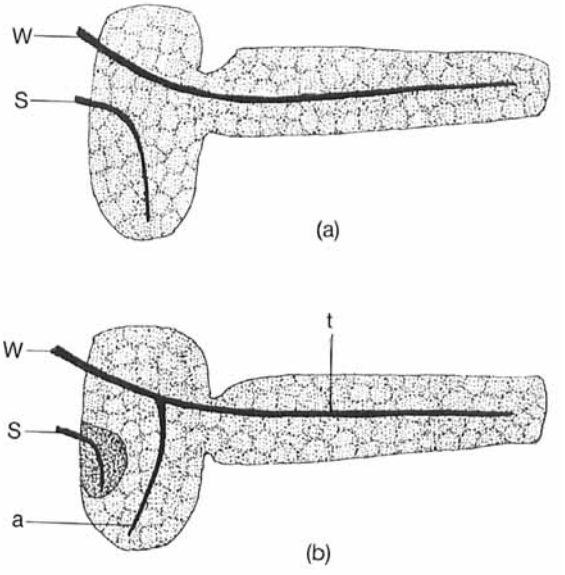


FIG. 1. Rhinoceros pancreatic duct arrangement (a) in the Indian and Sumatran forms according to Owen (1868) and Garrod (1873), (b) in the Sumatran, African black and African white forms according to present observation. a = ductus ascendens; S = Santorini duct; t = ductus transversus; W = Wirsung duct. Pars superficialis capitis stippled.

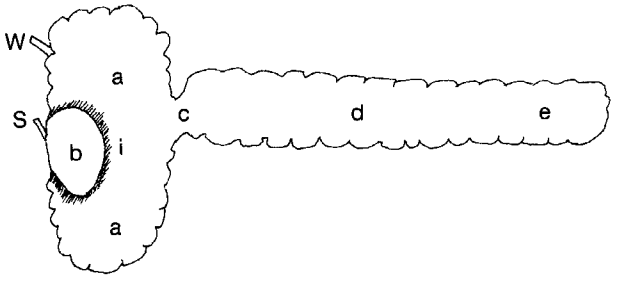


FIG. 2. *Didermocerus*. Topographical subdivision of pancreas. a = pars profunda capitis; b = pars superficialis capitis; c = cervix pancreatis; d = corpus pancreatis; e = cauda pancreatis; i = incisura capitis.

it to be radically different from the Owen-Garrod concept of rhinoceros pancreatic duct arrangement.

## Observations

Present observations of the disposition of the major ducts in the following formalin-fixed material:

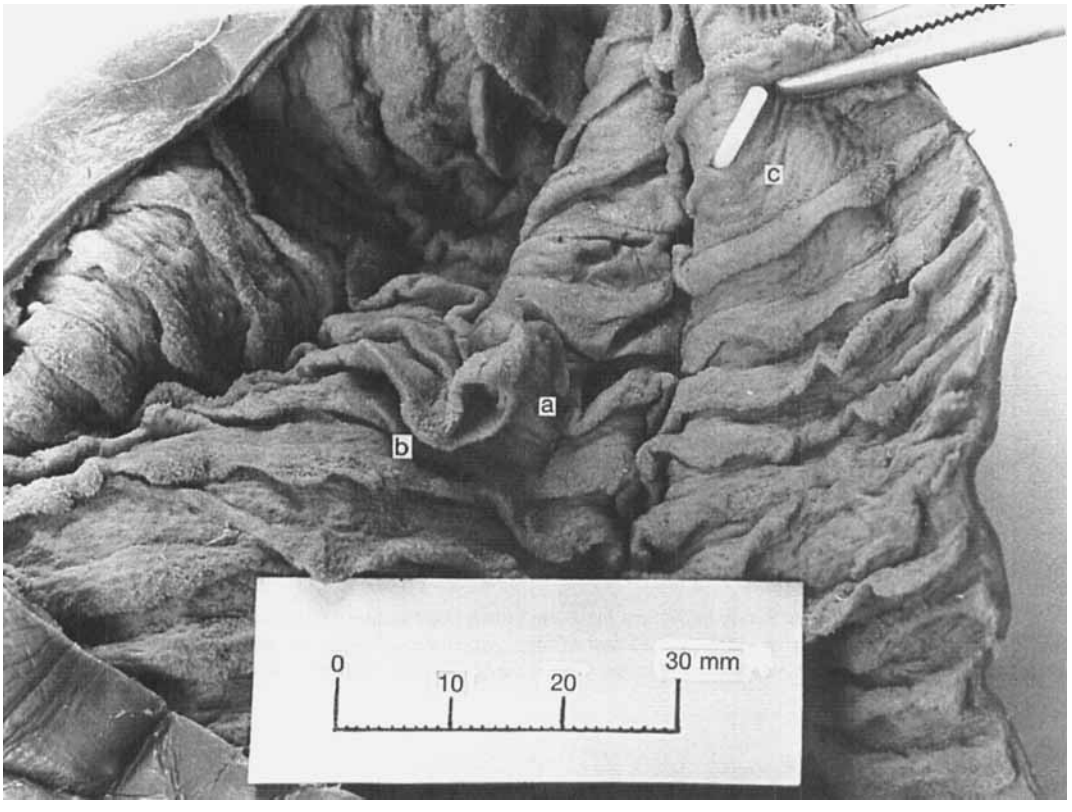


PLATE I. *Didermocerus*. Opened duodenum showing (a) papilla duodeni and Vaterian ampulla ostium, (b) plica preputialis, (c) white rod in Santorini duct ostium. Photograph by Michael Lyster.

| | | |
|---|---|---|
| *Didermocerus sumatrensis* | ad. female | Pancreas, dextral moiety |
| *D. sumatrensis* | ad. female | Pancreas, entire |
| *Diceros bicornis* | juv. female | Pancreas, entire |
| *Ceratotherium simum* | juv. male | Pancreas, dextral portion |

shows such disposition to display a standard pattern. Expectedly, in each of these specimens, the pancreas comprises a larger splenic and a smaller duodenal portion and is anchored to the wall of the pars descendens duodeni by the extremely short extraglandular extremities of its two terminal ducts, namely a major Wirsung, and a minor Santorini, duct. The pars splenica pancreatis embraces the topographical cervix, corpus and cauda pancreatis, the pars duodenalis the topographical caput pancreatis. This last is incompletely subdivided by an easily overlooked ventral incisura capitis into a large dorsal portion (pars profunda capitis) and a very much smaller ventral portion (pars superficialis capitis) (Fig. 2). The entire pancreas in these forms is thus composed of three parenchymal regions (the pars splenica and the two portions of the pars duodenalis) each of which is drained by an intrinsic principal duct, the pars splenica by a ductus transversus, the pars profunda capitis by a ductus ascendens and the pars superficialis capitis by a

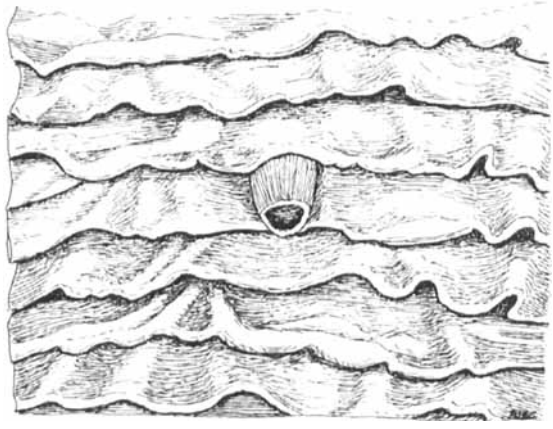

FIG. 3. *Diceros.* Duodenum interior showing papilla duodeni amid the duodenal plicae.

Santorini duct. The descriptive Wirsung duct is formed by the union of the transverse and ascending ducts (Fig. 1b).

The ductus transversus is the longest intrinsic duct: it arises in the cauda pancreatis, traverses the corpus and cervix and enters the cranial district of the pars profunda capitis, wherein it is joined by the ductus ascendens. The ductus ascendens is less than half the length of the ductus transversus; it arises in the caudalmost region of the pars profunda capitis, whence it proceeds cranialwards to join the transverse channel. The Santorini duct, much the smallest of the major intrinsic ducts, lies wholly within the pars superficialis capitis: it emerges from the deep aspect of the cranial end of this

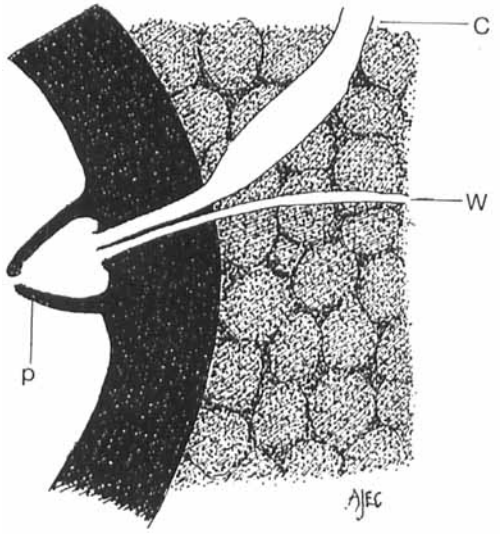


FIG. 4. *Ceratotherium.* Duodenal wall sectioned to show relation thereto of choledochus (C), Wirsung duct (W) and papilla duodeni (p) with Vaterian ampulla ostium.

region to pierce the duodenal wall almost immediately and to open into the duodenal lumen by a direct ostium concealed among the plicae duodenales; it constitutes the sole drainage channel of the pars superficialis capitis. The Wirsung duct is formed, as indicated, by the junction of the transverse and ascending ducts, and though larger-calibred than either, is relatively short. From its formation it proceeds dextrally through the pars profunda capitis towards the duodenal wall, and is accompanied by the distal end of the choledochus before meeting that wall.

These two channels pierce the duodenal wall obliquely and contiguously to open separately into the fundus of a Vaterian ampulla situated within a prominent papilla duodeni, frilled by the local plicae duodenales, the most apical of which is somewhat preputial in disposition (Plate I, Figs 3, 4). The ampullary mucosal lining is rifled and the ampulla ostium lies on the papilla apex. The direct entrance of the Santorini duct, and the indirect entrance of the Wirsung duct, into the duodenum are about equidistant from the pylorus.

Each principal intrinsic pancreatic duct is a thin-walled tube of white connective tissue, lined by a single layer of low columnar epithelium and strengthened by a sheath containing much elastic tissue; each receives a herring-bone succession of interlobular tributaries from its appropriate drainage area.

Anatomical arrangements demonstrate that the pars splenica pancreatis is drained exclusively by the ductus transversus, the pars profunda capitis by the ductus ascendens and the pars superficialis capitis by the Santorini duct. Contrary to received opinion, therefore, the Santorini duct is responsible for the drainage of but a relatively small portion of the rhinoceros pancreas, and the Wirsung duct for that of most of the gland.

It is probable that the pancreatic duct pattern presently observed in *Didermocerus, Diceros* and *Ceratotherium* obtains also in *Rhinoceros* and is thus canonical for the Rhinocerotidae.

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