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# Campylognathus Zitteli.

## A new Pterosaur out of the Upper Lias of Swabia

by

**Felix Plieninger.**

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With plate 19 and 8 text figures.

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## Literature index about Pterosaurs.

**Agassiz, L**. Memoires Soc. Nat. Neuchâtel. 1836. Vol. 1, pag. 19.
- Edinburgh new philos. Journal. April-Juni. 1843. Vol. 35, pag. 9.

**v. Ammon**. Ueber Rhamphorhynchus longicaudatus. Correspondenzblatt des naturwiss. Vereins in Regensburg. 1884. 38. Jabrgang.

**Anden, A. W**. Pterodactyles. Liverpool Geol. Assoc. Trans. 1884.Vol. 4, pag. 71.

**Andler**. Pterod. aus dem Angulatensandstein von Aichschiess. N. Jahrbuch f. Mineralogie etc. 1858, p. 645. Baur, G. Mr. E. T. Newton on Pterosauria. Geol. Mag. 1889. t. 6, pag. 171.
- The pelvis of the Testudinata with notes on the Evolution of the pelvis in general. Journal of Morphology. 1891.

**Bassani, F**. Sui fossili e sull' età degli schisti bituminosi triasici di Besano di Lombardia. Atti della società italiana di scienze naturali. Milano. 1886, XXIX.

**de Blainville, H**. (Osteographie.) pag. 9. Vol. 2.
- Description de quelques espèces de Reptiles de la Californie etc. Nouv. Ann. du Musée. Paris .1835. tome IV, pag. 238.

**Blumenbach**. Comment. regiae Societ. Göttingen. 1801. XV, pag. 144.
- Specimen Archaeologiae telluris. 1. 1803. p. 15.
- Handbuch der Naturg. 1803. 7. Aufl., pag. 703.
- Vergleich. Anatomie. 1805. S. 75, § 44.
- Beiträge zur Naturgescbichte. 1806. S. 119.
- Handbuch der Naturg. 1807. 8. Aufl., pag. 731•
- Handbuch der Naturg. 1825, pag. 620.

**Bonaparte, C. L**. Nuovi Annali delle Scienze Naturali. Bologna. 1838, Vol. 1, pag. 391. 1840, Vol. IV, page. 91.

**Boulenger, G. A**. Ann. u. Mag. of Nat. hist. 1891. Vol. 8, pag. 292.

**Bowerbank, J. S**. Proceedings of the geolog. Society. 1845.
- Quarterly Journal Geol. Soc. London. 1846. t. 1, Nr. 5, pag. 7.
- Microscopical Observations on the Structure of the Bones of Pterodactylus giganteus and other fossil animals. Quaterly Journal, 1848. Ser. 2, Bd. IV.
- Proceed. Zool. Soc. 1851. Pterod. Cuvieri.

**Buckland, W**. Geolog. Society Proc. 1829. Feb. 6, Vol. 1, p. 127. Referat darüber im N. Jahrb. f. Min. etc. 1830,
- On the Discovery of a New Species of Pterodactyle in the Lias at Lyme Regis. Pterod. macronyx. Transactions of the Geological Society of London. 1835. Serie II, Vol. 3, pag. 217.

- Bridgewater Treatise. 1836. pp. 221, 226, pl. 22.
- Geologie u. Mineralogie, übersetzt von Agassiz. 1838. Vol. II, Tab. 21 u. 22, p. 241.

**Burmeister**. Beleuchtung einiger Pterodactylusarten. Sitzungsberichte der naturforschenden Gesellschaft zu Halle. 1855. Bd. 3.

**Collini**. Acta Academiae Tbeodoro Palatinae. 1784. Bd. 5.

**Cope, Prof. E D**. Two new ornithosaurians from Kansas. Proceedings of the American Philosophical Society. 1872. pag. 471.
- Report of the United States Geological Survey of the Territories. Washington. 1875. Vol. If, p. 33 u. 249. Pl. VII, Fig. 1-4.

**Cuvier**. Reptile volant. Extrait Wan ouvrage sur les espèces de quadrupèdes dont on a trouvé les ossemens dans l'interieur de la terre. 1801. An 9. pag. 6.
- Annales du Museum. 1809. Vol. 13, p. 424, tab. 31.
- Recherches sur les Ossements fossiles. 1824. Vol. 5, Pt. 2, pl. 23, p. 359.
- Regne Animal. 1829. 2. ed. II, p. 43.

**Deffner u. Fraas**. N. Jahrbuch f. Min. etc. 1859. S. 12.

**Dollo, L**. Les Ptérosauriens. (P. v. Soc. hellte Géol. Hydrol. 1891. t. 5, pag. 174-175.)

**Duméril et Bibron**. Erpétologie générale. Paris. 1841. Vol. 4, pag. 549. Fikenscher, C. N. Jahrbucb f. Min. etc. 1872. pag. 861.

**Fischer**. Bibl. Palaeont. Moscou, 1834. Fitzinger. Systema Reptilium, 1843. p. 35. Fraas, Prof. 0. Beiträge zum obersten weissen Jura in Schwaben. Württ. Naturw. Jahreshefte. 1855. Pterodactylus primus. N. Jahrbuch f. Min. etc. 1859.
- Ueber Pterodactylus Suevicus. Palaeöntographica 1878. Bd. 25, pag. 163.

**Frischmann; L**. Versuch einer Zusammenstellung der jetzt bekannten fossilen Thier- und Pflanzenüberreste des lithogr. Kalkschiefers in Bayern. 1853. pag. 15. Eichs tätter Schulprogramm.
- Ueber neue Entdeckungen im lithogr. Schiefer von Eichstätt. N. Jahrbuch f. Min. 1868. p. 31. Fritsch, Dr. Anton. Ueber die Entdeckung von Vogelresten in der böhm. Kreideformation. Prag. Böhm. Gesellschaft. Sitz: Ber. 1881. p. 276.

**Gaudry, A**. Les enchaînements du Monde Animal. Fossiles Secondaires. Paris. 1890. pag. 235.

**Geinitz, Dr**. Pterodactylen. Isis. Sitz.-Ber. Dresden. 1877. p. 29.

**Gervais**. Zool. et Paléont. française. 1848-1852. pag. 265, tab. 51, Fig. 14-18. 1859. 2. Ausgabe, pag. 469.

**Giebel, C. G**. Fauna der Vorwelt. Leipzig, 1847. Bd. I. 1. pag. 87.
- Jahresbericht des naturwiss. Vereins zu Halle. 1849-1850.
- Allgem. Palaeontologie. Leipzig, 1852. pag. 231.
- Deutschlands Petrefacten. Leipzig, 1852. pag. 695.

**Goldfuss, Dr**. Beiträge zur Kenntniss verschiedener Reptilien der Vorwelt. Nova Acta Physico Medica Academiae Caesareae Leopoldino Carolinae. Breslau u. Bonn. 1831. pag. 63. Bd. 7.

**Hoeven, van der**. Verslagen en Mededeelingen van het K. Nederl. Institut over den Jare 1846. (p. 430.) Houzeau de Lehaye, A. (On Pterodactylian Teeth in the Hainault Chalk etc.) Soc. Geol. Belg. Ann. Bullet. Liege. 1875. XLIV. Vol. 2.

**Hulke, J. W**. Contribution to the Skeletal Anatomy of the Alesosuchia based on fossil remains etc. Proceedings of the zoolog. Society of London. 1888. pag. 417.

**Huxley, Th. H**. On Rhamphorh. Bucklandi a Pterosaurian from the Stonesfield Slate. Quarterly Journal. 1859. Bd. 15, pag. 658.
- Proceed. Zoolog. Society. 1867. pag. 417.
- Introduction to Classification of Animals. 1869. pag. 110.
- Anatomie der Wirbelthiere. (Deutsch v. Ratzel) 1873. pag. 226.

**Koken, Ernst**. Ueber Ornithoebeirus Hilsensis Koken. Zeitschr. d. Deutscb. geol. Gesellsch. 1883, Vol. 35, pag. 824. 1885, Vol. 37, pag. 214.

**Krieger**. Naturgeschichte II. S. 219.

**Lortet, Dr**. Les Reptiles fossiles du bassin du Rhone. Extrait des Archives du Museum d'Histoire naturelle de Lyon. 1892. t. V, pag. 128 ff.

**Lydekker, R**. Catalogue of the fossil Reptilia and Amphibia in the British Museum. London, 1888.
- On Ornithosaurian Remains from the Oxford Clay of Huntingdonshire. Quarterly Journ. London. 1890. Bd. 46, pag. 429.
- On certains Ornithosaurian and Dinosaurian Remains. Quarterly Journ. London, 1891. Bd. 47, pag. 41.
- Geol. Mag. 1890, Bd. 7, pag. 282. 1891, Bd. 8, pag. 46.

**Mantell, G. A**. Illustr. geolog. of Sussex. 1827. pag. 81.
- The Wonders of Geology. London, 1839. Vol. II, 492.
- Transactions of the geolog. Society of London. 1840. 2. Serie. Vol. V. I. pag. 175.
- Quarterly Journal geol. Soc. 1847. Vol. II, pag. 104.
- The Medals of creation. 1854. Vol. II, pag. 723.

**Marsh, Prof. 0. C**. Note on a new and gigantic species of Pterodactyle. Amer. Journ. Science. 1871. Vol. I, pag. 472.

- Discovery of additional remains of Pterosauria with description of two new species. Amer. Journ. Scie. 1872. Vol. 3, pag. 241.
- Notice of a new suborder of Pterosauria. Amer. Journ. Scie. 1876. Vol. 11, pag. 507.
- Principal characters of Amer. Pterodactyles (abstract of paper read before the Am. Assoc. for Advance ment of Science at Buffalo. August 28. 1876). Amer. Journ. Scie. 1876. Vol. 12, pag. 479.
- New Pterodactyle from the Jurassic of the Rocky Mountains. Amer. Journ. Scie. 1878. Vol. 11, p. 233.
- Note on American Pterodactyles. Amer. Journ. Scie. 1881. Vol. 21, pag. 342.
- The wings of Pterodactyles. Amer. Journ. Scie. 1882. Vol. 23, p. 251.
- Principal characters of American Cretaceous Pterodactyles. Amer. Journ. Scie. 1884. Vol. 27, pag. 423.

**v. Meyer, H**. Nova Acta Leop. 1831. XV. 2. S. 198.
- N. Jahrbuch f. Mineralogie etc. 1831. S. 72.
- Palaeologica zur Geschichte der Erde. Frankfurt a. M., 1832.
- N. Jahrbuch f. Mineralogie etc. 1837. pag. 316. 558. 560. 1838. pag. 415. 668.
- Beiträge zur Petrefactenkunde v. G. Graf Münster. I. u. V. Heft. 1839.
- Briefl. Mittheil. N. Jahrbuch f. Min. etc. 1842. pag. 303.
- N. Jahrbuch f. Mineralogie. 1843. S. 583. 1845. pag. 278 u. 282. 1846. pag. 463.
- Pterod. (Ramph.) Gemmingi aus dem Kalkschiefer von Solenhofen. Palaeontographica. Cassel. 1846. Bd. I, Lief. 1.
- Homoeosaurus IVIaximiliani u. Rhamphorhynchus (Pterodact.) longicaudus. Frankfurt a. M. 1847.
- Ueber die Reptilien u. Säugethiere der verschiedenen Zeiten der Erde. 1852. S. 134.
- N. Jahrbuch f. Mineralogie etc. 1852. S. 832. 1854. S. 51. 1855. S. 328. 1856. S. 826. 1857. S. 535. 1858. S. 62.
- Fauna der Vorwelt. Reptilien aus dem lithogr. Schiefer des Jura in Deutschland u. Frankreich. Frank-, furt a. M. 1860.
- Rhamphorh. Gemmingi aus dem lithogr. Schiefer von Bayern. Palaeontographica, Cassel. 1859-61. Bd. VII, pag. 79.
- N. Jahrbuch f. Mineralogie etc. 1861. pag. 467.
- Pterodact. spectabilis aus dem lithogr. Schiefer v. Eichstätt. Palaeontographica, 1861-1863. Bd. X, pag, 1.
- Pterodactylus micronyx aus dem lithogr. Schiefer von Solenhofen. Palaeontographica, 1861-1863. Bd. X, pag. 47.
- N. Jahrbuch f. Mineralogie etc. 1863. pag. 247. 1865. Pag. 845.

**Meyer, 0**. Ueber Ornithocheirus Hilsensis KoKEN. Z. d. Deutschen Geolog. Gesellschaft. 1884. Vol. 36, pag. 664.

**Münster, Graf G**. Ueber eine neue Art der Gattung Pterod. (medius). Nova acta pbys. med. Acad. Caes. Leop. Carol. 1831.
- N. Jahrbuch f. Mineralogie etc. 1832. S. 412. 1836. S. 580.
- Beitrage zur Petrefactenkunde. 1839. I. pag. 83.
- N. Jabrbuch f. Mineralogie etc. 1839. pag. 677. 1842. pag. 35.

**Newton, E. T**. New Species of Pterosaurian (Scaphogn. Purdoni). Philosophical Transactions of the Royal Society of London. 1888. Vol. 179, pag. 503.
- Notes on Pterodactyls. Proceedings of the Geologists Association. 1888. Vol. X, Nr. 8, pag. 406.

**Nicholson, H. A**. A Manual of Paleontology. 2. Aufl., 1879. Vol. II, pag. 222-229. 3. Aufl., 1889. Vol. 11, pag. 1196-1204.

**Oken**. Pterod. longirostris. Isis 1818. pag. 246. 1126. pl. 4. 1819. Sem. 11. p. 1705 u. 1788. T. 20, f. 1-4.

**Oppel**. Württemb. Nat. Jahreshefte. 1856. S. 326. 1858. S. 55.
- Juraformation. 1856-1858. S. 48.
- Pterodactylus-Vorkommen. N. Jabrbuch f. Mineralogie etc. 1858. pag. 116.

**Owen, R**. Odontography. London, 1840-1845.
- British Assoc. Reports. 1841. pag. 156.
- British fossil mammals and birds. 1846. pag. 545.
- Quart. Journ. Geol. Soc. 1846. Vol. II, pag. 96.
- Geol. Transactions. Ser. 2, Vol. V, pag. 170.
- Dixon's Geology of Sussex. 1850. pag. 401.
- Proceed. Zool. Soc. 1851. pag. 21.
- A History of british fossil Reptiles. 1851. Part. V.
- Palaeontogr. Soc. Monograph. 1851. pag. 80.
- British Assoc. Reports. 1858. pag. 97.
- Edinb. new philosoph. journ. 1859. Vol. IX, pag. 151.
- On the vertebral characters of the order Pterosauria. Philosopb. Transactions. London. (1859) 1860. Vol. 149, pag. 161.

- Monograph on Cretac. Pterosauria. Palaeontogr. Society. 1859-1860. S. 80 u. Suppl. I u. III.
- Palaeontology. 2. Auflage. 1861. pag. 270-275.
- Comparative Anatomy of Vertebrates. 1866.
- Palaeontogr. Society. Rept. Liasic Form. Pterosauria. 1869.
- A monograph on the fossil Reptilia of the mesozoic Formations. Palaeontographical Society. London, 1874-1889.
- History of British Fossil Reptiles. 4 Bande. London, 1884. Vol. I, pag. 463.

**Pictet**. Paleontologie. 1857.

**Quenstedt, F. A**. Pterod. Wtirttembergicus. Briefl. Mittheil. im N. Jabrbuch f. Mineralogie etc. 1854. pag. 570.
- Ueber Pterod. Suevicus im lithogr. Schiefer Württembergs. Tübingen 1855.
- Sonst und jetzt. 1856. pag. 130.
- Gavial u. Pterodactylus Württemberg:. Württemb. Nat. Jahreshefte. 1857. pag. 34.
- Ueber Pterodactyles liasicus. Württemb. Nat. Jahreshefte. 1858. pag. 299. Der Jura. 1858. pag. 812.
- Handbuch der Petrefactenkunde. 3. Aufl., 1885. pag. 219.

**Ritgen**. Nova Acta phys. med. Acad. Caes. Leopold. Carolinae Naturae curios. 1826. XIII. I, pag. 329-358.
- N. Jahrbuch f. Mineralogie etc. 1830. pag. 122.

**Sauvage, Prof. H. E**. De la presence du genre Pterodactyle dans le jurassique supérieur de Boulogne sur Mer. Soc. Géol. France Bull. 1873. Vol. 1, pag. 365.
- Recherches sur les Reptiles trouvés daps le Gault de l'Est du bassin de Paris. Soc. Géol. France Mém. 1882. Vol. 2.

**Seeley, H. G**. On the Literature of English Pterodactyles. Ann. u. Mag. of Nat. Hist. 1865. Vol. 15, pag. 148.
- On the Avian affinities of Pterodactyles. Ann. u. Mag. of Nat. Hist. 1866. Ser. 3, Vol. XVII, pag. 321.
- Index to the fossil remains of Aves, Ornithosauria and Reptilia in the Woodwardian Museum. Cambridge, 1869.
- The Ornithosauria. An elementary Study of the bones of Pterodactyles. Cambridge, 1870.
- Remarks on Prof. Owens Monograph on Dimorphodon. Ann. u. Mag. of Nat. Hist. 1870. Bd. VI, p. 129.
- Additional evidence of the structure of the head in Ornithosaurs from the Cambr. Upper Greensand. Ann. u. Mag. of Nat. Hist. 1871. Vol. 7, pag. 20.
- On an Ornithosaurian (Doratorhynchus validus) from the Purbeck Limestone of Langton near Swanage. Geol. Soc. Quat. Journ. 1875. Vol. 31, pag. 465.
- On the organization of the Ornithosauria. Linn. Soc. Journ. (Zool.). 1878. Vol. 13, pag. 84.
- On Rhamphocephalus Prestwichi. Quarterly Journal. 1880. Bd. 36, pag. 27.
- On evidence of two Ornithosaurians referable to the genus Ornithocheirus from the upper Greensand of Cambridge. Geol. Mag. 1881. Vol. 8, pag. 13.
- Reptile Fauna of the Gosau formation etc. Quarterly Journal. 1881. Vol. 37, pag. 620.
- Phillip's Manual of Geology. 2. edition, 1885. pag. 517.
- On the bone in Crocodilia which is commonly regarded as the Os pubis etc. Proceedings of the Royal Society. 1887. Vol. 43.
- The Ornithosaurian Pelvis. Ann. u. Mag. of Nat. History. 1891. Ser. 6, Vol. VII.

**Sömmering, S. Th. v**. Denkschrift. der kgl. bayr. Akad. d. Wissenschaften. 1811-1812. Bd. III, S. 89. 1816-1817, (public. 1820). Bd. VI, Abt. 7, S. 89-104. 1816-1817 (public. 1820). Bd. VI, Abt. 8, S. 105-112.

**Spix**. Geschichte aller Systeme. S. 249. 371.
- Ueber ein neues vermutblich dem Pteropus Vampirus zugehöriges Petrificat. Denkschrift der Münchener Akademie d. Wiss. 1816. p. 59.

**Terquem, M**. Obs. sur le lias da dép. de la Moselle. Metz, 1847. p. 17.

**Theodori**. Froriep's Notizen für Natur- und Heilkunde. 1830. Nr. 623, pag. 101. .
- Isis. 1831. pag. 276.
- Ueber Pterod.-Knochen im Lias von Banz. Bericht des naturforsch. Vereins in Bamberg. 1852. p. 17.

**Thiollière**. Sur les gisements a poiss. foss. situés dans le Jura du Bugey. Lyon, 1850.

**Wagler, Dr. J.** Nattirliches System der Amphibien. München, 1830. pag. 60.

**Wagner, A**. Abhandlungen der bayr. Akad. d. Wiss. 1837. 11. pag. 163
- Gelehrte Anzeigen, herausgegeben von Mitgliedern der k. bayr. Akademie d. Wissenschaften. 1851. Nr. I. 14. Juni. 1851. Nr. II. 3. Juli.
- Abhand. d. bayr. Akad. d. Wiss. 1851. VI. Bd., 1. Abth., pag. 12:), tab. 5. 6. 1852. VI. Bd., 3. Abth., pag. 690, tab. 19.
- Gelehrte Anzeigen, berausgegeb. v. Mitgl. d. k. b. Acad. der Wissensch. 1857. Nr. 21. 17. August. Nr. 22. 19. August.
- Abhandlg. der bayr. Acad. d. Wiss. 1858. VIII. Bd., 2. Abth., pag. 439, tab. 15-17.
- Geschichte der Vorwelt. 2. Aufl., 1858. 11. Theil, pag. 443.

- Vergleichung der urweltlichen Fauna des lithogr. Schiefers von Cirin mit der gleichnamigen Ablagerung im fränk. Jura. Gelehrte Anzeigen, berausgegeb. v. Mitgl. der k. bayr. Acad. d. Wiss. 1860. April Nr. 28 u. folgende Nummern.
- Fische und Saurier im oberen wie unteren Lias. Sitzgs.-Bericht d. math.-physic. Classe der k. b. Acad. d. Wiss. 1860. p. 45. 12. Mai.
- Abhandlg. d. k. bayr. Acad. d. Wiss.1861. IX. Bd., 1. Abth., pag. 113, tab. 5.
- Foss. Rept. d. lithogr. Schiefers. Sitzungsber. d. If. b. Acad. d. Wiss. 1861. 1. pag. 497.

**Williston, Dr. S. W**. Ueber Ornithocheirus Hilsensis KOKEN. Zoolog. Anzeiger. 1885. Vol. 8, pag. 628.
- The Kansas University Quarterly. July. 1892. Vol. 1, Nr. 1.
- The American Naturalist. 1891. pag. 1124.
- The Kansas University Quarterly. October. 1893 Vol. 2, Nr. 2.

**Winkler, Prof. T. C**. Description d'un nouvel exemplaire de Pterod. micronyx du Musee Teyler. Harlem. 1870.
- N. Jahrbuch f. Mineralogie etc. 1871. p. 112.
- Harlem Mus. Teyler Archives. 1874. Vol. 3, p. 84.
- Le Pterod. Kochi du Musee Teyler. Harlem. 1874.
- Harlem Mus. Teyler Archives. 1874. Vol. 3, p. 377.
- Note sur une espèce de Rampb. du Musee Teyler. Harlem Musee Teyler Arch. 1883. Vol. 1, pag. 219.

**Woodward, H**. Geol. Mag. 1868. Bd. 5.
- The Flying Lizards of the secondary Rocks. The intellectual Observer.
- New Facts bearing on the Inquiry concerning Forms intermediate between Birds and Reptiles. Quarterly Journal. London, 1874. Bd. 30.

**Woodward, A. Smith**. Ann. u. Mag. of nat. History. 1891. Serie 6, Vol. 8, p. 314.
- (Dasselbe in) Evidence of the occurrence of Pterosaurian and Plesiosaurian Reptiles in the Cretaceous Strata of Brazil. British Assoc. Cardiff meeting. 1891. p. 299-300.
- and Ch. D. Sherborn. A Catalogue of british fossil vertebrata. London, 1890.

**Zittel, K. A. v.** Ueber Flugsaurier aus dem lithogr. Schiefer Bayerns. Palaeontographica, 1882. Vol. 29, pag. 49.
- Handbuch der Palaeontologie. 1887-1890. Bd. III, p. 773.

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# Introduction.

The Middle Posidon strata of the Lias in Swabia contain wonderful *Ichthyosaurus* and *Teleosaurus* remainders and also "Swabien Jellyfish " which are well known. In more recent time, the inexhaustible quarry pits, much talked about, at Holzmaden by Kirchheim again yielded an *Ichthyosaurus* with a complete tail fin and other similar fossils[1], as well as the first skeleton of a *Plesiosaurus* to be found in Swabia. These two findings are followed by the finding of a Pterosaur in the strata of the Lias of Swabia and Franc, which is the first almost complete specimen. The fossil came from the quarry of owner and Fossil Dealer B. Hauff of Holzmaden, it was acquired with accustomed skill from the rock outer layers. The Society For Natural Ancestors in Württemberg acquired the specimen which was entrusted to me by the present Conservator of the geological collection, Professor Dr. Eberhard Fraas, this grand and worthy discovery, the description for which I here express my warmest thanks. I am also obliged to thank Her. Geheimrath v. Zittel, who fully supported me in preparation of the piece with his estimable knowledge, and allowed me free and extensive use of his significant private library in the most amiable manner. I dedicate this Species as a sign of my heartfelt thanks to my distinguished friend Mr. Lehrer, who expanded the knowledge of the Pterosaur so substantially, and my admiration. Also Dr. Otto Reis, assistant at the Kgl. Berbergamte to Munich, I am obligated to thank for his great support. The text figures were drawn by Mr. Conrad Krapf.

# History.

The first remainders of Liassic Pterosaurs were discovered in the December of the year 1828 in the lower Lias of Lyme Regis in England and were described by Buckland[2] as *Pterodactylus macronyx*; The Genus *Dimorphodon* was established later by Richard Owen. In this specimen, the largest part of the skeleton was discovered but the skull was absent.

After this English find was published, Hermann von Meyer[3] discovered in the palaeontological collection of the Duke Wilhelm of Bavaria at Banz in the year 1830, similar remnants of pterosaurs, which had been collected in the spring 1828 in the vicinity from Banz from the Middle Posidon strata of the upper Lias. Hermann von Meyer[4] and Theodori[5] busied themselves with the publication of these fossils. First they recognized the English *Pterodactylus macronyx* Buckland, later they identified Species different to the English one, namely *Pterodactylus - Pterodactylus (ensirostris) - banthensis*. This fossil example was classified by A. Wagner[6] in 1860 as the Genus *Dorygnathus*. Oppel[7] described a well-preserved lower jaw of the same species from the Boller area out of the Middle Posidon strata. After Quenstedt[8], a specimen from Wittberge in Metzingen; which was recovered at Nachtgraben, where the lower jaws of the Oppel partial fossil being a part of the Front extremity of a Pterosaur, and another fossil classified as a short tailed pterosaur, named *Pterodactylus liasicus*. In the year 1858, Richard Owen[9] recovered a skull of *Dimorphodon macronyx* Buckland and later an almost complete skeleton of the same species; the exact description of both fossils was published in the year 1870[10]. Out of the upper Lias of Whitby, E. T. Newton[11] described a specimen as *Scaphognathus purdoni* a rather large, *Scaphognathus* skull in excellent condition.

The specimen to be described here more closely of a Lias strata Pterosaur comes from the Middle Posidon strata (Lias & Quenstedt), associated with Ichthyosaurus remains, being discovered in the year 1893. It has proved to be one of the earliest Lias pterosaurs and also earlier than the Chalk specimens, so in progress of the treatise; I propose therefore the name *Campylognathus*[12] for this new Genus.

# Description.

**Situation and maintenance.** (s. plate. 19.)

The skeleton lies on a 75cm wide and 98cm long slate and was prepared by the skilful preparator B. Hauff. The creature settled on its left side during fossilization and is almost complete. Neck and head hang over the dorsal side, in sequence the skull has its right side exposed; it is well presented in its rear aspect being part-pressed, otherwise, the preservation is complete. The lower jaw halves are separated, the right half lies below the skull and was displaced left becoming visible through it. The neck section of the spinal column is totally crushed up so that single turbulences cannot be recognized. The turbulences of the back and loin section are somewhat dispersed, just as the ribs, of which nine of the left body half lie and they are complete, probably in the original sequence. Sacral and tail sections are preserved magnificently. Both sides of the united scapulae and coracoid are preserved by the shoulder girdle. Through the scapula of the right slate, the humeral distal endings are absent due to a fracture of the slate. The sternum is seen only incomplete, it lies behind the skull. Of both front extremities, we almost completely see those of the right side as single articulated bones. The distal end of the humerus, as well as the proximal ending of ulna and radius are absent from the right front extremities while the remaining part of that is finely exposed. The humerus of the left side lies under scapula and coracoid and humerus of the right extremity. Radius and ulna are entirely complete. Carpus and metacarpal are missing, with exception of the fifth Metacarpal, which is curved below part of the skull. The first is an impression, which lies diagonally over ulna and radius, its distal end by the phalanges of the fifth or flight finger; the proximal end is lacking close to the second phalange, which lies in the corner of the slab with the third and fourth phalange on.

The maintenance condition of the slab is quite magnificent; the pubis unfortunately is missing, possibly concealed in the rock. The right hind extremity lies next to the front part of the tail and totally in connection; however the distal end of the tibia of the distal tarsus line is somewhat displaced. Of the left hind extremity, the head of the femur lies next to the pelvis; tibia and fibula lie hidden under the hip and lower thigh of the right side, obscured at the proximal end. Tarsus and metatarsus are articulated while the phalanges are mixed up somewhat. Almost all extremity bones are in places compressed due to their pneumatic state.

## Skull.

The front half of the skull (fig. 1) is well preserved, tough the bones of the rear half, are displaced and crushes somewhat into separated pieces, the displaced bones and fairly intact and grouped together so that the skull shape can be recognized. Viewing the almost complete skull, from the aspect of the right side, first of all three large fractures can be seen around the orbit, which are separated by bone bridges disconnected from each other. The biggest aperture forms the orbit (orbit, 0.). The sclerotic ring is turned over and well preserved, being displaced behind and above the original position. The height of the orbit is between 2.5 and 3cm, its width is about 3 cm. In front of the orbit, is a triangular aperture the small opening (Preorbital opening P.), the same one at its basis 1.8cm long and 0.6cm high. It seems its original height was reduced by some pressure. Above and forward of this middle aperture, is the nares (N. as a third opening), with a height of 0.6cm and a length of 4cm. The position of the nares is low on the skull.

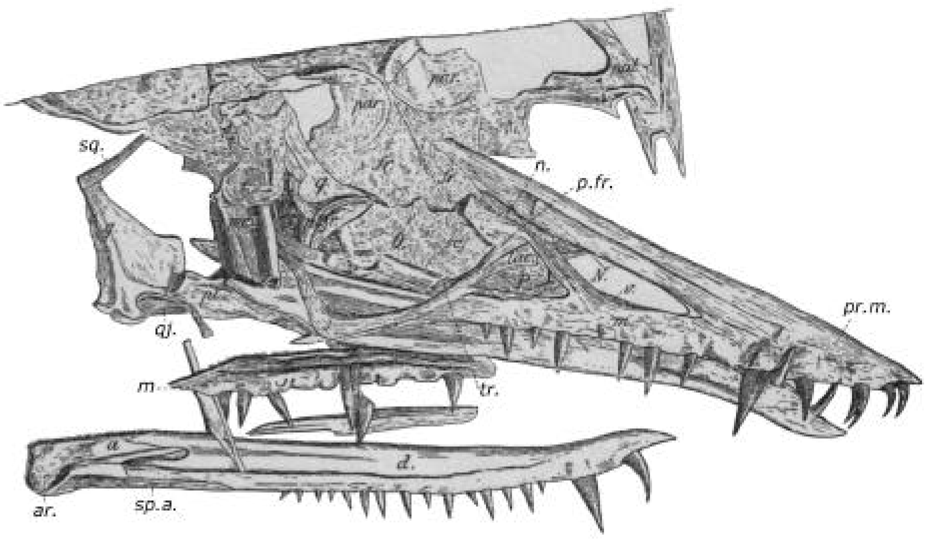



**Fig. 1**

The length of the entire skull, which can be determined because of the damaged rear partly can be estimated to be 13cm. The skull roof formed by top of the skullcap and forehead is displaced from its original position, somewhat distorted, is shifted in the direction towards the orbit and giving a complete view of the bones in sequence. Lastly we have the top of the skullcap (Parietal par.), which forms the semicircular upper orbit interior, to the rear of this semicircular opening. Two curved strips extend between the ophthalmic and temple openings, joined at the median line and passing around the temporal opening into the just mentioned opening. In the complete deficiency of a seam, the boundary between top of the head and nasals is difficult to determine. Von Ammon[13] identified this in *Rhamphorhynchus longicaudus* Munster "a line curving slightly forwards, progressing around the parietal depression" the boundary between forehead and top of the skullcap. "In the same manner," von Ammon goes on, "the parietal depression against the frontal boundary is clearer on the Munich specimen of *Rhamphorhynchus Gemmingi*, which Wagner described as *Rhamphorhynchus longimanus*."

On latter specimens, this line is formed by a strip and in both specimens; the progress of these lines is on others as in our specimen. That these developed lines should collapse along the sutures appears to be because of the further progress of these strips to the rear, at least very unlikely in *Campylognathus*. Below the top of the skull cap, lie the frontals (Frontals fr.), which form the upper edge of the orbit; this might be the point of collapse, extending therefore to the front area of the outer edge of the orbit. This place would correspond, which is seen in *Scaphognathus crassirostris* Goldfuss shows a suture at that place to be a boundary between frontals and between the jaws. Also an image of *Rhamphorhynchus longicaudus* Munster, which H. von Mayer[14] described, shows the suture at the same place. The media line is set in *Campylognathus* by a pronounced elevation, having collapsed at the boundary of both Frontals and was perhaps the basis of a fine ridge, as seen recently in the preparation of a *Pterodactylus* out of the lithographic limestone which will give an opportunity to be described soon. Laterally before the forehead lies at an angle the somewhat damaged front the orbit the front prefrontal (p. fr.) The form of this bone is not to be determined exactly. By the prefrontal in the rear upper corner of the preorbital opening, lies an oblong triangular Lacrimal (lac.) whereas its still, incomplete preservation leaves us unclear of its form. Before that frontal, between prefrontal, Lacrimale and the rear extension of the mid jaw line, lies the nasal (n.) By pressure something under the prefrontal and Lacrimal has been displaced, which may be the limitation of the preorbital opening towards the top taken in that it dispatches forward below a rather long and narrow structure, that extends at a rising branch of the upper jaw; it terminates furthermore at the nares to the rear. The paired premaxilla (pr. m.) begins before the frontals, separates itself from the frontals and widens gradually forward into the snout tip. It limits the nasal opening above and ahead and forms the foremost part of that to the tip of the snout. A partially fused suture, which separates the upper jaw can be recognised, it is however, what Goldfuss supposed in *Scaphognathus crassirostris*, to from the front angle of the nares beginning behind the fourth tooth the alveolus. I will state the reason, which lets me acceptance this as justified, in discussion of the lower jaw. Owen misplaced this border wider according to Hinten[15] and also Seeley[16] pay attention to different interpretations to the expansion of Maxilla and Premaxilla in Owen's treatises. The upper jaw (Maxilla m.) is solid at the front of the premaxilla; The nasal cavity of low, sloping upwards at the rear, joining with the nasal bones, from the Preorbital opening, sloping backwards to join at the Jugal. The Maxilla of the left side is disconnected from the skull and is found beneath the skull between both lower jaws. In the separate pushing of the skull bones through pressure, the bones associate themselves closely at the suture junctions; we measure now the length of the free lying upper jaw, we find that this measurement is the same as from the Jugal to the fourth tooth when measured from the tip of the jaw. This would therefore be the front boundary of the Maxilla, which Owen, without proof, makes such an assumption.

The zygomatic arch (Jugal j.) passes over a thin, archiform bone clasp, which forms the lower boundary of the orbit, straight forwards into the upper jaw and one forwards on increasing branch the prefrontal against which it separates the orbit from the preorbital cavity. At the connection place of Maxilla and Jugal is positioned at the front lower corner of the orbit and inside there is a bony structure that can be interpreted as an os transversum (tr,.)

That described skull bone until now had remained associated in the sediment, and we can now make the interpretation that the whole skull was more or less shifted out of its original position. Behind the skull, the quadrate bone (Quadrate q) of the left side, exposed on its inside, forms a rather strong triangular bone disk, at whose upper end almost right-angled a handle shaped structure must belong to the squamosal (Squamosal sq,.) and is obviously incomplete, located at the lower end with the wing-like structure of the parietal forming a seam between the quadrate and squamosal. At the bottom end is the quadrate, rounded, forming at the lower jaw in the shape of a deep ridged trochlea. A strong strip passes the rear edges parallel, that forks before it reaches the lower corner, and dispatches a branch forwards and downwards. The Quadrate formed the rear limitation of the temporal opening.

At the internal lower edge, forward of the Quadrate, is a flat bone, which appears to be the pterigoid (pterigoid pt.). Extending from here is a curiously flattened scalp extending as a small edgewise structure. Lying under the lower edge of the Quadrate and covered, is most of the pterigoid, covered as is the quatrojugal (quatrojugal qj.) The interpretation from the outside is that the Quadrate was in union with the Jugal.

The Quadrate of the right side is pushed into the orbit and lies at the rear upper edge of that; it is entirely is covered it by the rear postfrontal (postfrontal pt. fr.) This, a three forked weak piece of bone, whose branches must abut below the Jugal, towards and forward of the frontal and parietal, behind with the squamosal, dissociated from the upper temple opening, limited the orbit behind above and separated it by the temple openings. Lying within the nares, and completely visible, is a long, narrow bone interpret as a vomer (vomer V.). Next to or rather over the skull two overlapping bones are located. I consider in the upper part, a bone branching off that forms the limit of a partially oval opening, as a palatine (palatine pal.), the lower shape is not clearly seen, and perhaps it corresponds to the other palatine, however the interpretation of both is at the least very uncertain. In the orbit, a compressed bone mass, in which one believes to recognize flattened bones of round shape, lies the remainders of a sclerotic ring (sc.) At this point I have completed the bones in this sequence.

The taking of the single bones at the limitation of the openings in the skull is following:

- The nares limit: premaxilla ahead and above, maxilla below and through a rising branch fully behind. Nasal behind above.
- The preorbital opening limit: maxilla below and through a rising branch fully ahead. Nasal above, Lacrimal behind above, Jugal behind below.
- The orbit limit: frontal above, prefrontal ahead, Jugal ahead and below and behind below. Postfrontal behind above.
- The lower temple opening limit: postfrontal and Jugal ahead and above, quadratojugal below, Quadrate behind.
- The upper temple opening limit: parietals interior, squamosal interior and behind, postfrontal exterior and ahead.

## Lower jaw.

Both lower jaw halves (s. fig. 1), which were not obviously fused at the symphysis, lie apart and displaced backwards; the right half slightly to the rear and adjoins almost in its original situation at the skull. The left half inverted beneath the right, both with external sides exposed, are 11.5 cm long, reasonably strong and with a down curved tip 0.6 cm long. The rear part of the mandible are straight, and the front third curves downwards downward to the tip; the toothless short tip is straight on top and rounded upwards at the lower edge.

The most powerful bone, the toothed part is the dental (d.), behind and above is the narrow supra-angular (sp. a.), which can be clearly defined. At the rear end, the articular (ar.) with the joint socket for the quadrate. A portion behind the joint area is missing. The articular is weakly delimited by sutures. Forwards and close below is the angular (a.) which is clearly separated from the dental by a suture. The four named bones supra-angular, articular, angular and dental surround a depression, which crosses obliquely from the top to the back forming a thin bone bridge; a cavity does not exist. R. Owen[17] observes a similar space in the lower jaw of *Dimorphodon*. From this structure, two shallow grooves radiate, of which the upper passes through the almost entire dental to the tip, gradually flattening and disappearing to the end, the lower groove is the same for the rear third then disappears. The rear lower end of the lower jaw seems compressed somewhat so that the form of this involvement is no longer entirely original. The description of this rear part is taken from the left half because this place of the right is covered by whole skull. The outside of the lower jaws appears with the exception of shallow grooves in the forward flat area, that height measured from the tip at about three quarters back, is about 0.9 cm, in the last rear quarter are the mandible the edge is rounded to the inside.

# Evidence.

**a. Upper jaw and jaw fragment**

In the premaxilla and maxilla (s. fig. 1) there are 13 teeth and two alveoli, which can be recognized clearly. On the premaxilla there are eight complete teeth, four complete on each side of the muzzle. Because the snout became compressed laterally in the sediment, all four distal teeth are visible, that two of the right and those of the left side. After these two distal teeth follow two teeth, the third vertically emplaced, leaning laterally, and somewhat forcefully, behind this tooth, the fourth, the largest of the entire row; is placed ahead of, the boundary between premaxilla and maxilla. The following tooth which is on the maxilla is absent, follow three teeth of different size follow the one that has fallen out; next is an alveolus, then yet four teeth of changing size follow consecutively. In the whole maxilla, the teeth from the front to the back, the absent teeth are nowhere to be found. The left maxilla whose inside of which is exposed shows the manner of attachment of the teeth, of which a portion are partly displaced from the alveolus, some teeth remaining firmly in the alveolus. It first, appears to me however probably that the internal jawbone was lost in the preparation of the specimen. Some teeth of the upper jaws are seen to leave a shallow depression; the largest tooth in the left maxilla has a strong furrow on the inside.
On the premaxilla, there are four teeth, on the maxilla there are nine teeth.

**b. Lower jaw.**

On one half of the lower jaw there are seventeen teeth. The two front-most stand separate and are especially large, being 0.6 cm apart, behind these are fifteen significantly smaller and fine teeth also with an interval of 0.6 cm. The first of these fifteen stands smaller, similar to the four hindermost, scarcely standing more than a 0.1 cm over the Alveolar edge. The remaining array varies in size, but none jutting out over 0.5 cm.

**Microscopical findings.**

Ten teeth were removed from their alveoli for microscopical investigation, the largest of which was the fourth tooth of the premaxilla. This was cut widthways through the tip a lengthways through the remaining portion of the structure.

In the cross section, which was about 0.2 cm from tooth tip recognized by the cracked mass of ground dentine, where the inner tooth is rather crushed, it is distorted though the form can be recognised as an ellipse. The enamel forms a moderate thick layer and seems to be restricted to the tip of the tooth because it is only visible at the cross-section but is not seen in the long section. It is colourless, prismatic, and shows clear laminations and is just as if the mass of ground dentine is double ruptured. In the central region of the cross-section, around the pulp cavity, the dentine layer rises almost vertically upwards in moving gradually against the outside of the tooth, without reaching however the horizontal situation. The progress of the dentine layer can be clearly followed in the long section, but was not found in this the pulp cavity at the base, the reason is probably due to the compression of the tooth. The enamel layer is missing and only the dentine can be recognised; at the root, we see the Cement with its bone corpuscle.

# Spinal column.

The spinal column (s. fig. 2) is with exception of the Sacral sections and the tail unfortunately very badly preserved. The neck section is only indicated by a compact bone mass, however we see, like in all Pterosaurs, there are perhaps seven neck vertebra; this is acutely crooked while the remaining sections of the spinal column form a straight line. Only some vertebra are complete in the trunk section; they overlap one another significantly in size so that they might have quickly decreased in size therefore from front to rear; all are decidedly procoel.

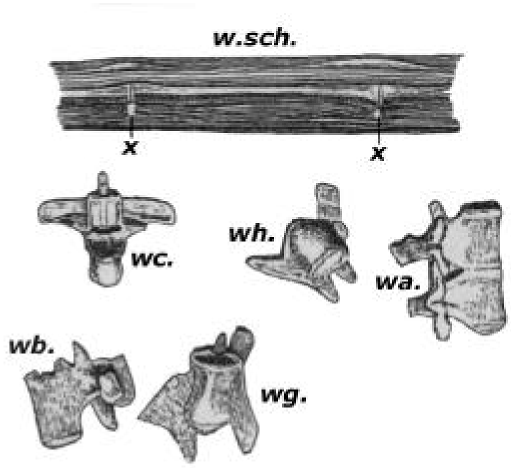



**Fig. 2.**
*wa*, *wb*, *wc*. Back vertebrae.

*wh*. and *wg*. proximal tail vertebrae

*w. sch*. twelfth tail vertebra with point x marking two vertebral joints.

Nat. Size

The vertebra (*wa* fig. 2) beautifully expose the front concave and the rear convex joint surfaces; they show several of the joint surfaces in the vertebra designated with *wb* and *we*, the front joint surface the fine vertebra *wc* most clearly. The front-most thoracic vertebrae (fig. 3 *we* and *wd*) have very high, wide neural spines of square shaped form which decrease against the Sacral section quickly in size and circumference. All vertebra of the thoracic region have front and rear zygapophyses. The joint area of the front zygapophysis is arranged to the inside and above, in the rear outward and below; vertebrae *wd*, *we* and *wf* on fig. 3 show us this relationship. The front zygapophyses are covered therefore by the rear of the preceding vertebra. The transverse processes of the thoracic vertebrae are magnificent in vertebra *wc* (fig. 2) and some of the remaining thoracic vertebrae are also well preserved. In the front thoracic vertebra, the process for the capitulum is at the basis of the diapophysis (vertebra *wc*), and moves gradually towards the end of the diapophysis where the process is also located for the tuberculum. Because the ends of the ribs have two heads, the processes for the capitulum and tuberculum are always apart, this is the shape. In the vertebrae *wa* and *wb* there are no protuberences for the rib heads at the end of the diapophysis, the preservation is however not the kind to show the shape. In the vertebra designated with *rw* (Taf. XIX) only the centrum is preserved, marked with a cross. As soon as the zygapophyses are detached this seems how it, appears. Of the lumbar region, another vertebra lies projecting, it appears to be connected flexibly with the sacral section although a little obscured, are yet neural spine to recognize transverse process and zygapophyses. At the Sacral section (fig. 5) there are four complete vertebrae, which have a joint length of approximate 2.8 cm; they are connected immovably with one another, however a suture between each can be recognized clearly. They possess very low, wide neural spines and strongly broadened and extended transverse process, which stand off almost rectangular in the first sacral vertebra, sooner with weak inclination forwards, in the two following somewhat obliquely to the rear, in that fourth and last rectangular or rather more forwards. The Sacral vertebrae increase in size and length in the proximal area. Of the tail section, we see the first vertebra still in articulated union with the Sacrum, having the same wide, strong, rectangular extended transverse processes. The tail vertebrae as in *wg* and *wh* (fig. 2) rest beyond connection; some are probably lost.

Now follows a segment of 32 vertebrae (Taf. XIX) with a length of 56.35 cm. With the names vertebra being the entire 35 tail vertebrae preserved. The two more freely lying tail vertebra (*wg* and *wh*) show their zygopophyses towards the rear and somewhat downward arranged spinal processes. At the fourth and fifth tail vertebrae, which are preserved in connection with the whole tail, the spinal processes are more at the rear part of the vertebral centra and are seen to decrease in length so that in the fifth vertebra shows a button shaped process; the zygopophysis of vertebrae 4 and 5 can be seen to cross the prezygopophyses. Because the tail lies on the side of the spinal processes only that one is to be seen on the right side. The tail vertebrae following up to the 8th increase quickly in length, 8 and 9 are equally long, at the 9th the length decreases slowly; they are strong and lengthened cylindrically, in the centre somewhat converging on the underside. In the vertebrae 9-16 at the border, there are two processes at the base of the vertebra where they join, seen as ventral processes of bone, which probably add to the strengthening and support of the tail as well as the prezygopophaseal sheath itself (fig. 2 *w. sch.*, x.) H. v. Meyer[19] observed such pieces in *Rhamphorhynchus* also, regarded it however as the ending of prezygopophyses. The entire tail is surrounded by a formal sheath of such ossified tendons. These prezygopophyses and heamapophyses extend themselves on the dorsal side of the tail further forwards as on the ventral (s. Taf. XIX); It seem to extended itself even to part of the Sacrum, as observed also by Owen in Dimorphodon. Sometimes the prezygopophyses seem to fuse with one another and to form a narrow ribbon in the short length towards the end of the tail. A specimen present in the Munich collection of a *Rhamphorhynchus Gemmingi*, whose prezygopophyses are clearly laid out separately, shows these relationships very clearly.

## Arrangement of the Long Vertebra

### Dorsal Vertebra

| Length of vertebra / cm | |
|---|---|
| *we* | 0.9 |
| *wf* | 0.8 |
| *wb* | 0.7-0.8 |
| *wa*[20] | 0.75 |
| *wa* | 0.75 |

| Length of vertebra / cm | |
|---|---|
| *rw*I | 0.8 |
| *rw*II | 0.8 |
| *rw*III | 0.75 |
| *rw*IV | 0.7 |
| | |

Diametre of Centrums of vertebra *we* is 0.45 cm.

### Tail Vertebra

| Length of vertebra / cm | | |
|---|---|---|
| 1 | ca. 0.7 | |
| 2 | ca. 0.7 | |
| 3 | ca. 0.7 | |
| 4 | 0.9 | |
| 5 | 1.3 | |
| 6 | 2.5 | |
| 7 | 3.3 | |
| 8 | 3.5 | Max. |
| 9 | 3.5 | Max. |
| 10 | 3.45 | |
| 11 | 3.4 | |
| 12 | 3.25 | |
| 13 | 3.15 | |
| 14 | 2.9 | |
| 15 | 2.75 | |
| 16 | 2.5 | |
| 17 | 2.2 | |
| 18 | 2.0 | |

| Length of vertebra / cm | |
|---|---|
| 19 | 1.85 |
| 20 | 1.5 |
| 21 | 1.4 |
| 22 | 1.2 |
| 23 | 1.2 |
| 24 | 1.1 |
| 25 | 1.0 |
| 26 | 1.0 |
| 27 | 0.85 |
| 28 | 0.75 |
| 29 | 0.7 |
| 30 | 0.7 |
| 31 | 0.6 |
| 32 | 0.6 |
| 33 | 0.5 |
| 34 | 0.4 |
| 35 | ca. 0.3 |
| | |

## The Ribs.

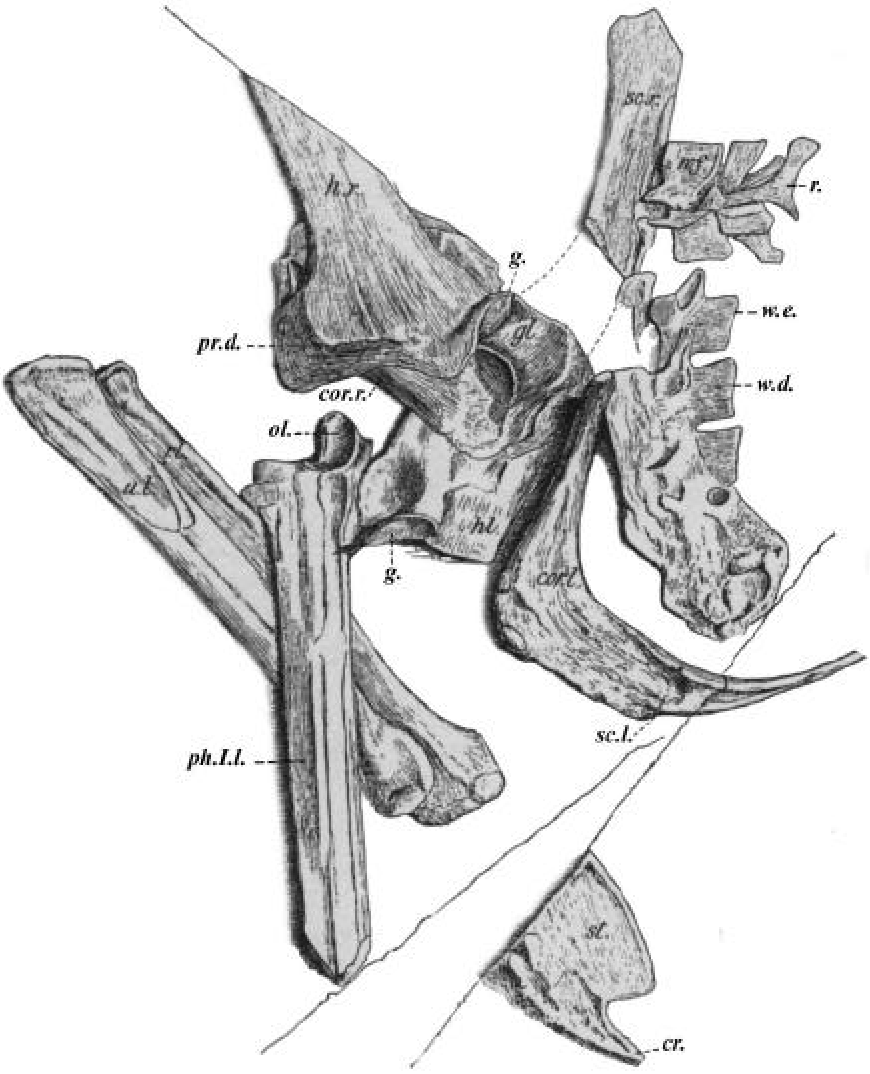
Only a few ribs are preserved, they are noticeably thin with a thickening at the distal end, at the proximal end as in two figures. Two ribs r and r' (Tab. XIX and fig. 3) are particularly strongly qualified; belong in any case to the first trunk vertebra. Like many of the front rib itself through it has significant strength, it seems, courageously two or three, like in most Pterosauria. I measure the longest rib to 6 cm, the shortest at approximately 5 cm. A series of 9 ribs remained in their original sequence and situation; they are preserved in more or less good condition. Of that dispersed fragmented ribs, some show a clear long furrow. Disks of bone fragments is how they occur in Ramphorhynchus as appendages of the belly rib or as sternal parts of the front rib, were obscured.

## **The Shoulder Girdle** (*s*. Fig. 3).

### Scapula and coracoid (shoulder blade and sternum support).

Scapula and coracoid can be seen preserved on both sides so that its form can be seen. The bones are fused with one another; that of the right side (fig. 3, sc.r. cor.r.) is seen from the outside and the left (sc.l. cor.l.) has its inner side exposed. Through the scapula of the right side, a wide socket in the bone is seen, however the bones are so exactly are joined that a precise fit is possible. The Scapula bone is broad in shape and crooked, 6-6½ cm long, against the distal end the width reduces and flattens itself, on the second bone on the side of the specimen with the inside exposed, this is clear and a F outward below arranged against rounded edge. The height of that flattened side is about 0.9 cm. The inner surface is 1 cm wide showing what seems a weak single groove that is now somewhat smashed, but would have been smooth.

At the external side of the right scapula (sc. r.), against the proximal end to the joint (gl.) humerus is clearly seen in place, are it strongly increases with a 0.6 cm long cut in between, which serves to the location for the ball joint. Further along at the joint surface, there is a section on which a strong consolidation follows before which another rounded process lies, but it is not very clearly preserved. This process borders on the weakly indicated seam, which passes between the united scapula and coracoid. The coracoid has a length of 3.6 cm, is prolate, bevelled in the rejuvenated end to the alignment on the sternum, somewhat inward bent, laterally spatulate and oblately blunt on the vertical edge. The coracoid of the left side (cor. l.) is turn with the inside exposed, covering the outside of the right coracoid (cor. r.) by the large end of right humerus. A bump shaped process at the union with the scapula is weakly indicated.




| **Fig. 3.** | Sc. r. = Right scapula. | Sc. l. = Left scapula | Ph. 1st l. = First Phalange of the left flight finger |
|---|---|---|---|
| Cor. l. = Left coracoid | Gl. = Joint area at the shoulder blade | H. r. = Right humerus | Wd., we., wf. = Turbulence of the front back area |
| Pr. d. = Deltoid process of the humerus | G. = Joint area of the humerus | H. l. = Left humerus | Oiled. = Ole- cranonartiger process of the prox imal end of that |
| U. l. = Left Ulna | St. = Sternum | Cr. = Crista sterni | |
| R. = One of the frontmost rib | R. l. = Left radius | Cor. r. = Right coracoid | NATURAL SIZE |

## **The breastbone** (sternum).

The sternum, is a thick bone seen behind the skull, Fig. 3 (st.), It is interpreted through a gap in the matrix where the rock has been broke off whole. The piece is obscured and seems damaged and needs to be exposed in the preparation. Obviously here is presented a round shield shaped bone plate. In the sediment, the sternum was exposed along the axis so that only the half is visible. The interpretation indicates crista at the edge.

## The Forward Extremity (*s*. Fig. 3 u. 4).

### a. Humerus (upper arm - *s*. Fig. 3).

Of both Humeri, only the proximal end lies forward, as well as a short piece of the shaft, that is intact, the distal end is lost into the matrix. The Humerus is exposed at the proximal end with the wing stretching out, the left Humerus (h. l.) still beautifully exposed, is vaulted outwards and concave on the inner surface. The joint union (g) is formed by a thickening at the upper edge of the wing bone expansion shaped; it has a length by about 1 cm and a width of approximately 0.5 cm, is weakly concave and inclined against the external edge. Next to the place, which carries the joint surface through a shallow separate deflection, is located the deltoid processes of the humerus (pr. d.), it is good on the right Humerus (h. r.), corresponds well to the left which is reversed; next to the joint connection on the inside is a smaller process. Only a smaller, flat depression is preserved, which is close to an originally rounded fistula, by the shaft.

### B. Ulna and radius (forearm).

Both sets of forearm bones, Ulna and radius, of the right and also of the left body half remained. That the right side (Taf. XIX, and r and r. r.) lacks the proximal end, that the left side bones against it (quickly. 3 and l. and r. l.) are completely preserved. Both bones are about 8.2 cm long, almost equally strongly, the radius somewhat weaker; they lie very close, however they are clearly separated. Because they are flatly pressed, the form of the joint areas is somewhat indistinct. The Ulna possesses at the proximal end no Olecranon, which is somewhat thickened. The radius seems appears at the proximal end to have a slab shaped broadening which is consolidated while the Ulna was rounded off. Distal both bones appear with round joint thickenings, also there are thickened bulges to be observed (fig. 4, and r. and r. r.)

### c. Carpus (hand bones).

The carpus of the left extremity is absent, that of the right however is preserved. It consists clearly of four small pieces (fig. 4, a, b, c, d), two larger and two smaller where always a larger and a smaller piece are in the proximal and distal rows. The larger of the proximal row (a) is narrowly and long and sits on the distal end of the ulna and likewise on the radius and interpolates with a small vertical tip between both forearm bones, probably as an Ulnare + Intermedium, which is the smaller (b) of the proximal row, that locates itself at the radius and laterally on the larger (a) of the same row, which is considered to be the radial.

In the distal row, the larger of both knuckle bones (c) extended itself at the metacarpal of the fifth wing finger; here one sees a projection in the proximity of the remaining metacarpals from it. The small knuckle bones of the distal row (d) puts itself laterally on a and c and locates at the ulna with its upper surface, and the lower surface with the metacarpal of the flight finger. A similar position is seen in a specimen of *Rhamphorhynchus Gemmingi*, located in the Münchener Museum , shows similar forms of the hand bones described by H von MEYER[21] which has not been fully described before. Actually only the bone pieces of the proximal row was observed; while regarding the second Knuckle bones of the first and the knuckle bones of the second row uncertain.

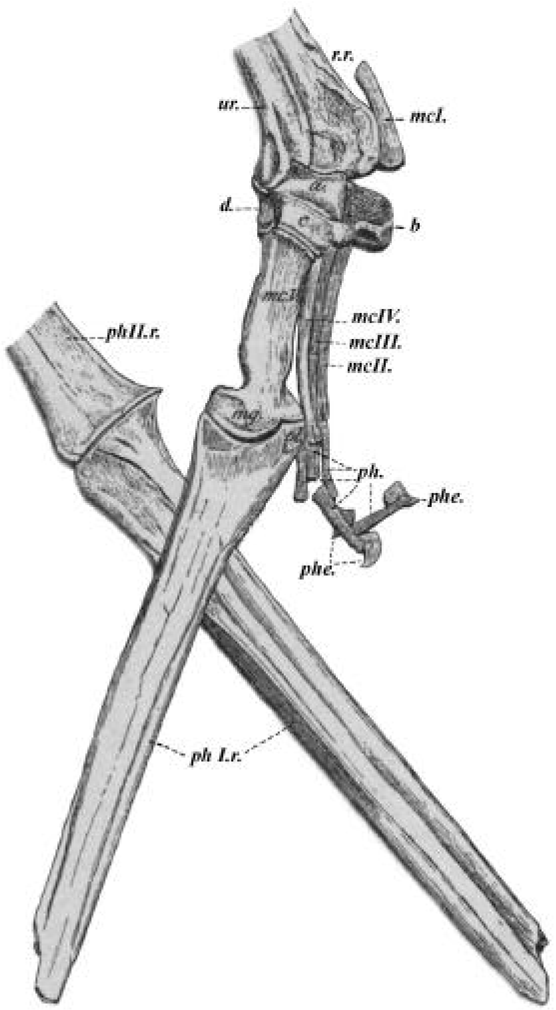



**Fig. 4.**

a, b, c, d = carpus
Mc V = metacarpal of the fifth finger
Oiled. = Olecranonartiger process
Phe. = Klauenförmige Endphalange

*u. r.* = right Ulna
McI. = So-called instep bone
Mg. = Roll joint the same
PhII. r. = Second Phalange of the right flight finger

*r. r.* = right Radius
McII, III and IV = metacarpals
PhI. r. = First Phalange of the flight finger of the right side
Ph. = Phalangen of the remaining fingers
Nat. Size

## d. Metacarpus (means hand).

Received is the middle hand of the right side, of the left only metacarpal is retained and it is incomplete; it is compressed near the rear part of the skull. The metacarpus (fig. 4 mc) consist of four approximately equally bones of about 3 cm long, somewhat more than 1/3 the length of the forearm. That sturdy metacarpal (mc. V) exceeds the remaining three in strength; the right side exposes its external surface. The external side of the same seems to have been rounded and shows moreover a 1.3 cm long bulge. The front was flattened, and weakly rounded. The proximal joint area seems much flatter than the distal and has a hollow joint pulley (mg) in the middle providing a location for the wing finger phalange. Next to this external metacarpal lie the thickened three remaining metacarpals (mc IV. III. II.) as 0.1-0.15 cm thick and 3 cm of long knuckle bones; on the distal ends they carry 0.2-0.3 cm of long grooves which terminate at the joint head ending. Next to the radius, as interpreted by H. von

Meyer and Wagner, as a incurved bone, Goldfuss, Marsh and v. Zittel designated the bone piece as a backward turned metacarpal the designated rudimentary developed thumb (mc. I); it is 1.6 cm long, 0.2 cm thickly and slightly crooked. Fixed in this position, it might have turned in with its rounded end at the radial carpal bone (b) of the proximal row.

## e. Phalanges.

### a. The phalanges of the flight finger.

Both of the phalanges of the fifth or flight finger are preserved, of the right as the left hand. The distal end of the first Phalange of the left flight finger is broken off, just as is the proximal end of the second. The phalanges of the right hand are completely preserved, the first is broken in two and lie is pieces crossing over one another, the condition of preservation however is more favourable as the broken areas fit clearly together. The first flight finger phalange of the right side (fig. 4, ph I r) has a length of 18.5 cm. The proximal ending of the first phalanges both sides (fig. 4, ph 1ST r and fig. 3, ph I. 1) show clearly the olecranon forward triangular process (oiled) which is obviously a powerful muscular extensor. The first Phalange of the right hand shows in joint union with the metacarpus, that of the left hand very well the joint face with two pits to receive the articulation of the fifth metacarpal at the proximal end, as well as the olecranon forward process from within; the latter raises itself 0.6-0.7 cm over the broadened end of the Phalange and is convex outside, concave within. The centre of the first Phalange is almost 1 cm wide, seems squashed flat by the way and to have been originally completely round. Against the distal end the Phalange is flattened again and continues to form an articulation with the second Phalange (fig. 4, ph II. r) a flat joint area and just cropped off. That thickened ends every phalange, naturally with exception of the last. The second Phalange has a length of 20.9 cm, taken from the proximal to the distal end it thickens, later in the middle to 0.7-0.8 cm. The third Phalange has a length of 16.5 cm, is in its middle is 6 cm wide and slims down itself also. The fourth and last Phalange, with a length of 12.15 cm, weakly curved, becoming slim and continuing to the distal end to form into a rounded tip.

Groupings of the lengths of Wing Finger phalanges

| Phalange | cm |
|---|---|
| I | 18.50 |
| II | 20.90 |
| III | 16.50 |
| IV | 12.15 |

### b. The phalanges of the remaining fingers (s. fig. 4 ph, phe terminal limbs).

The phalanges of the second, third and fourth finger are almost completely preserved; the first finger has the familiar backward curve. The second finger is formed by two phalanges, where the first is an approximately 1.1 cm of long and 0.1 cm of thick small bone rod, the second, similar phalange, is lying squeezed beneath the second phalange of the third finger. The third finger consists of three phalanges, the first the same as the fourth metacarpal, clearly not longer than 0.7 cm; the second phalange which follows is 1 cm long, then the third terminal end phalange. In the fourth finger by the four phalanges, only three are clearly preserved. The first is seems long, the second lies under the second phalange of the third finger and to about 0.7 cm strongly exposed in the preparation; its estimated length is 0.6 cm; the third phalange is 1 cm long; the fourth is again the pinch shaped terminal.

## **The Pelvis** (figure 5).

The pelvis is seen fused to the sacrum and masterfully prepared. It is observed, to be attached to the sacrum on four vertebrae but not the fifth, joined with strong transverse processes, but with the forward sacral vertebra free. The flattened transverse process of the four vertebrae are connected to the ileum, they are strongly extended in front of and behind the bone plate which is 4.8 cm in overall length. That part of the forward ileum process (il) is rounded off to a thin and wide bone plate, which extends from the sacrum by approximately two vertebra lengths. The rear process (il') is 1.4 cm long, narrower than the front, but stronger and curving upwards, the end vertically truncated; extending scarcely more than a vertebra length beyond the sacrum. The width of the pelvis amounts to almost 4 cm. At the ileum, with this firmly located, connect themselves the ischium (ischium, ileum.) Both are seen from the inner side on the specimen.

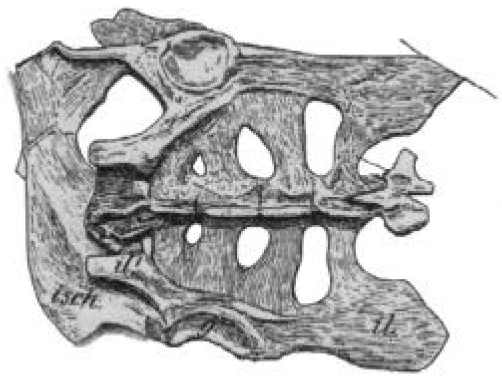



**Fig. 5.**
*il.* = front, *il'* = rear process
*Ileam.* *fisch.* = Ischium.
*g.* = Joint socket.
Nat. Size.

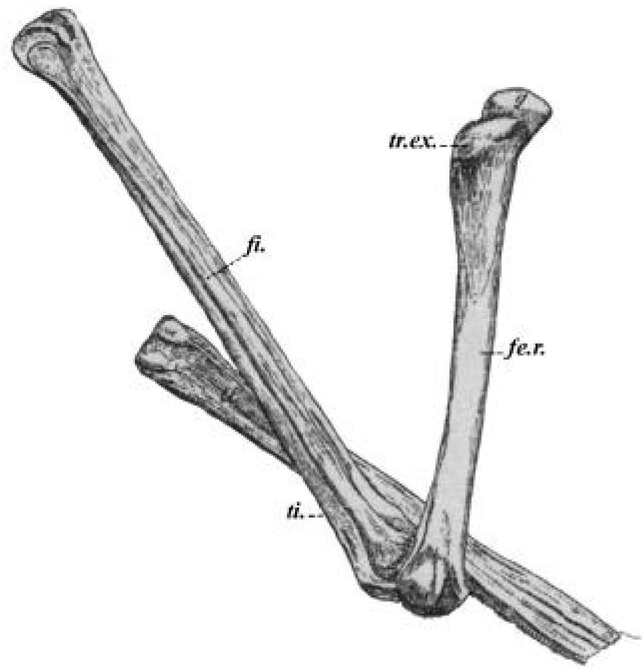
The right side is better preserved, and shows the original form and situation clearly. In proximal view, the bony plate extends behind and below to a strong plate of approximately triangular shape, reducing towards the distal end. Both bones are inclined against each other to the rear and inward, perhaps in contact even with its distal end, which is truncated. The socket (g) is surrounded by Ileum and Ischium. The pubis is not seen; it might be concealed under the front part of the pelvis concealed in the matrix, which cannot be exposed without damaging the exposed bones.

## **The Hinder Extremities** (fig. 6-s).

### A. Femur (Thigh Bone).

The thigh bone is preserved in both hinder extremities; it has a length of approximately 6.5 cm and consists of a bone which is weakly curved forwards. The centre has a diameter of approximately 0.4 cm. The right Femur (Fig. 6, fe. r.) shows the outer and front aspect, the left offers (Fig. 7, fe. l.) is seen from its outside and back aspect.

At the proximal end to the direction into the pelvic socket, a hemispheric joint head is located (Fig. 6, g), which, at the end of a short and thick neck, is weakly rotated obliquely upwards. In the left Femur, the femur head is concealed in the rock. Beneath the neck, an external trochanter (tr. ex) is located which is rather strongly developed. The right femur is somewhat damaged while the left is completely preserved, seen from above and laterally exposed. On the front of the femur, between the neck of the head and the trochanter a gash is observed. At the distal end, the thigh bone thickens and carries two deep furrows to the articulation which connects with the lower leg. The external edge of the articular pulley seems also to articulate with the fibula, which is observed at the right extremity.



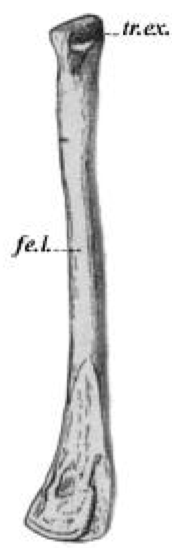




**Fig. 6.**
*fe. r.* = right Femur. *tr. ex.* = muscle Trochanter.
*g.* = ball of Femur. *ti.* = Tibia.
*ft.* = Fibula. Nat Size.

**Fig.7.**
Upper leg.
*fe.l.* =left Femur.
*tr. ex.* = muscle Trochanter.
Nat. Size.

## b. Tibia and Fibula (lower thigh).

The second section off rear extremity consists of two bones, the shin bone (tibia) (fig. 6, ti) and the pin bone (fibula, fi). They are preserved on both sides; however the proximal end is missing on the left side and the fibula there cannot be recognised while that of the right side is articulated with the femur. The tibia has a length of 8.8 cm, you, clearly associated closely for almost its entire length with the fibula (fi). The tibia possesses a bone projection at the proximal end which juts out in front over the knee joint; in the centre, it has a diameter of about 0.5 cm. The distal end is moderate broadened, forming a joint articulate pulley at the extremity; an indistinct seam is seen towards proximal tibia where the tarsus is fused near the articular head, being therefore similar to a tibiotarsus, like at of birds. As already mentioned, the fibula is seen as a thin bone fused with the tibia at the knee joint; the bone is thin away from the knee joint, thickening proximally towards the joint with the femur; distal it extends almost to the lower end of the tibia, but not joining with the foot bones, its length to tip 8.5 cm.

## Tarsus (foot base). (S. fig. 8.)

The proximal row mentioned with the tibia joint. The distal row consists of two ankle bones (fig. 8, tr.), however they seem to be a smaller and a larger displaced at both extremities.

A fragment of a *Rhamphorhynchus Gemmingi*, which is located in the Münchener Museum and shows a well-preserved tarsus, matches in only two ankle bones of the distal row while the proximal row is fused with the Tibia.

H. von MEYER[22] has made the same observation on two specimens of *Rhamphorhynchus Gemmingi*, i.e. it has two tarsus ankle bones, just as R. OWEN[23] attentively observed on the fusion of the proximal tarsus row with the tibia in *Dimorphodon*. Recently WILLISTON[24] shows a diagram of a complete hinder extremity of *Pteranodon*, assigned two tarsal bones and the rudiment of a fifth digit while the proximal row is fused with the Tibia.

## Metatarsus (middle foot), fig. 8 (m I, II, III, IV and V).

The five metatarsals are irregular, long and slender, the fifth very shortly and close; they have been preserved lying abreast. The first metatarsal (m I) has a length of 3.8 cm, the second (m II) 4.1 cm, the third (m III) 4 cm, the fourth (m IV) 3.6 cm, the fifth (m V) about 1 cm. The thickness of the four first metatarsals amounts to scarcely more than a 0.1 cm, that of the fifth between 0.3-0.4 cm, from the proximal to the distal end. All metatarsals, with exception of the first, touch the two ankle bones of the distal tarsus row. The position of the first seems to be lying in the correct position for the sequence, originally positioned forwards and upwardly curved (concave plantar surface).

## Phalanges of the toes (s. fig. 8).

Five well formed toes, the fifth are is shortened significantly covered by its accompanying metatarsal. The last phalange of the four first toes is a spatulate claw and fifth toe is only weakly curved. The first toe consists of two phalanges, the first is 1.5 cm long, the second, that is the end phalange, spatulate. The second toe consists of three phalanges, the first is 1.1 cm, the second measures 1.15 cm and the third is ended in the claw. The third toe consists of four phalanges, of which however two, the second and third are fused together; the fusion is weakly indicated by a seam. First phalange 1.05 cm, second and third phalange together 1.6 cm (0.5 and 1.1 cm), the fourth again the claw is. The fourth toe consists forms of five phalanges, of which the first 0.9 cm of the second 0.6 cm, the third also 0.6 cm that is long fourth 0.7 cm the fifth the claw. The fifth toe is clawless and carries two phalange2 whose first measures 0. 95 cm, and the second one measures 0.5-0.6 cm. The second phalange is weakly curved and bending backwards. We saw therefore that the phalanges of the toes increases from the first to the fourth by a phalange at each toe (the fused phalanges of the third toe calculated individually), therefore amounts to 2, 3, 4, 5, though fifth toe consists however only of two members.

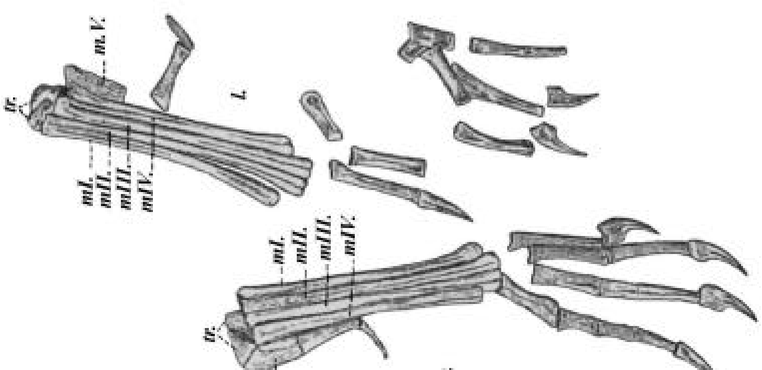


**Fig. 8**. Tarsus, Metatarsus und Phalanges.

| | |
|---|---|
| *r*. = right foot. | *tr*. = two ankle bones of the distal tarsus row. |
| *l*. = left foot. | *m* I-V Metatarsals |

Nat. Size

## Relations of Campylognathus Zitteli to Dorygnathus, Dimorphodon, Scaphognathus, Rhamphocephalus and Rhamphorhynchus.

### 1. Relations to Dorygnathus.

In the year 1852, THEODORI[25], excellently described the isolated complete skeleton of *Dorygnathus* held in the Banzer collection. *Campylognathus* compares well to with this distinguished near complete skeleton in its observed form or proportions; it was considered to be the case that the Banzer specimen was just of a different Individual.

The lower jaw of *Campylognathus* shows some important differences of both lower jaws of *Dorygnathus*, of which the one is located in the Banzer collection, that another, which has come from Wittberge in Metzingen, itself in the Münchener palaeontological collection. To closely seen in *Campylognathus* above all that the long, toothless, dagger shaped extension of the jaw Symphysis is missing, as well as the widening and deflecting of the jaw in the area of the fangs, furthermore in *Dorygnathus* the lower jaw halves in the Symphysis are fused and in the case of *Campylognathus*, obviously they were not. In *Dorygnathus* in the lower jaw contains three fangs, or rather three larger alveoli for such while *Campylognathus* possesses its only two. Nevertheless the lower jaw of *Campylognathus* is shorter than both those of *Dorygnathus*, is yet the number of the teeth following on the fangs in latter a fewer. The lower jaw follows in *Dorygnathus* to the Symphysis in a straight line while it is curved forward and downward in *Campylognathus*. Even so, the latter is absent from *Dorygnathus* on the outside of the lower jaws running with a high squared edge strip; further the lower jaws in *Campylognathus* are much closer, thicker and shorter on the outside, with exception of a depression at the rear end, which is not observed in *Dorygnathus*, it being almost smoothly.

Grouping of the lower jaw lengths, the number of the fangs and smaller teeth in both lower jaws of Dorygnathus and of Campylognathus:

| | | Lower jaw length. / cm | Count of fangs. | Number of smaller teeth. |
|---|---|---|---|---|
| Dorygnathus | Metzinger Example | 16.0 | 3 | 9 |
| Dorygnathus | Banzer Example | 13.2 | 3 | 11 |
| Campylognathus | | 11.4 | 2 | 15 |

The scapula and coracoid are fused in *Campylognathus* as well as in *Dorygnathus* and they are of the same shape, though the rounded process is more strongly formed at the union of the scapula and coracoid in *Dorygnathus* and the bones appear stouter and broader; this is in agreement the main relationship rules, this emphasizes the larger shoulder girdle belonging to *Campylognathus* which is bigger than that of *Dorygnathus*, though the lower jaw shows the reverse ratio. Also the Humerus shows the only insignificant differences to be that the rounded the deltoid process in *Campylognathus* is more angular; furthermore in *Dorygnathus*, the deflection is deeper, which separates the flight muscle process from the deltoid process at the joint. There are differences however in the measured ratios between ulna and radius and the first phalange of the flight finger in both specimens. In the case of a third of the Dorygnathus finds of the forearm found with the first flight finger phalange on a slab lying together, the latter measures 10.5 cm and the first (without the flight finger phalange process) 9 cm and the fifth Metacarpal length is 3.4 cm, we have in flight finger phalange a forearm of 8.2 cm, and a first Phalange of 18.5 cm length (without the process) while the fifth Metacarpal measures 3 cm. For clarity I present the numbers once again in a table:

| | Ulna und Radius | Metacarpale V | Phalange I |
|---|---|---|---|
| Campylognathus | 8.2 | 3 | 18.5 |
| Dorygnathus | 10.5 | 3.4 | 9 |

We see therefore that in *Campylognathus* the first flight finger phalange is long and about than double the length of the forearm, whilst that in *Dorygnathus* is much shorter than the latter, it is observed in *Dorygnathus* that the leading bones are smaller; the remaining skeleton of the Banzer specimen is less well suited to comparison.

## 2. Relations to Dimorphodon[26].

The skull of *Dimorphodon* is in the relation to the rest of the skeleton significantly larger than that of *Campylognathus*, also it is significantly higher and appears less stretched in appearance, like the skull of the latter. There are conspicuous differences in the openings both skulls. In *Dimorphodon*, the nasal opening is a little larger than the preorbital opening, whilst the orbit is smaller than both; in *Campylognathus* on the other hand the orbit excels both other apertures in size. In *Dimorphodon*, the skull bones altogether appear altogether smaller, whereas the lower jaw in *Campylognathus* has more numerous rear teeth which are noticeably smaller. The back vertebrae and tail are very similar, likewise are the scapula and coracoid which appear in the relation to the size of the skull, smaller. The wing process at the proximal end of the Humerus is smaller in *Dimorphodon*. The first flight finger phalange in *Dimorphodon* is twice as short as the forearm length. Th e length of the flight finger phalanges increase in *Dimorphodon* from the first to the third, in the flight finger phalange of the first to the second also, hereafter reducing. In the Carpus, we have four bones in both species, each having a large and small bone in the proximal and distal row. Metacarpals, phalanges number of the remaining fingers, as well as that so-called instep bones show agreement[27]. The pelvis seems to show resemblance, especially in the Ischium, as far as in the poor preservation of the English fossil allows a comparison can be made. The rear extremity is significantly larger in *Dimorphodon*. In both fossils accordingly, the fusion of the proximal tarsus row with the tibia are seen, that Metatarsals in Dimorphodon are shorter and the entire fifth toe longer, also the second and third phalange of the third toe in Dimorphodon is more curved.

## 3. Relations to Scaphognathus Purdoni Newton.

This skull described by Newton[28] shows less resemblance with *Campylognathus*. Clearly the skull openings are different in form and size. In *Scaphognathus purdoni*, the preorbital opening is the largest and oval in shape; in *Campylognathus*, the orbit is the largest opening and the preorbital opening is of triangular shape. In *Scaphognathus* the orbit lies higher, at the same time forming a V shape, much closer, wider and shorter jugal. Although the skull is longer in *Scaphognathus* Purdoni, the skull roof is yet narrower and it be missing the strips. The nasal opening in Campylognathus lies further to the rear against the orbit to over the preorbital opening, the postfrontal is weaker and thinner, the maxilla shorter while it passes in *Scaphognathus* under the middle of the V shaped jugal. The quadrate is very divergent. The skull of the *Scaphognathus purdoni* however differs from that of *Scaphognathus crassirostris* from Solenhofen exhibiting some different features, probably being a separate generation.

## 4. Relations to Scaphognathus crassirostris Goldfuss.

*Campylognathus* seems to resemble *Scaphognathus crassirostris* on the first view; on closer inspection however serious differences arise. So first of all in *Scaphognathus* the nasal openings are smaller than the preorbital openings, in *Campylognathus* it is the opposite case; the nasal openings are narrower and longer, also the bone bridge between nares and the preorbital aperture is less solid; the orbit larger as in the case of *Scaphognathus*, extends further down, and buts up against the irregular end of the jugal. The quadrate bone and the triangular Preorbital opening are analogous. The skull roof was narrower in *Scaphognathus* and in comparison with the length obviously higher, also it shows no strips. The evidence in the premaxilla is in both forms alike, that in the maxilla in *Scaphognathus* is less similar. A main difference in the lower jaw, is the maxilla in *Scaphognathus* which has only few large teeth at the tip, anteriorly truncated while in *Campylognathus* the lower jaws from back to front increases in size, in its front part after the downward inflection it shows a short toothless tip, seen as slender and rounded below; in addition in the rear part of the lower jaw are shallow grooves. Furthermore we see two large fangs and fifteen smaller teeth in *Campylognathus* while *Scaphognathus crassirostris* possesses only five teeth. Scapula and coracoid are separated in *Scaphognathus*, less extended at the joint and the coracoid hatchet shaped, which is not observed in *Campylognathus*. On the fusion of scapula and coracoid by the way no conclusion is to be made because in *Rhamphorhynchus longicaudus* Münster in specimens of the same size, these bones are separated and fusion may be observed. The first flight finger phalange in *Scaphognathus* is about 1/3 shorter than the forearm these being the forearm bones, although they are smaller than in *Campylognathus*, they are long and thinner than those of the first phalange which is about double the length of the forearm. In both forms, the phalanges of the first to the second increase at size.

## 5. Relations to Rhamphocephalus[29].

*Rhamphocephalus* is different in the skull structure and in the evidence. The skull is strongly formed between the eye sockets and contains the lower jaw few teeth that increase to the rear in size bearing no relation to *Campyl ognathus*

## 6. Relations to Rhamphorhynchus.

The openings in the skull of *Rhamphorhynchus* are very different to those of *Campylognathus*. Nasal openings and preorbital openings appears very small vis-á-vis the eye sockets, therefore the skull much lower in its front half. The teeth are arranged obliquely forwards, and not vertically standing as formed in *Campylognathus*, and in the lower jaw significantly more in number and much largely than in latter; also the quadrate deviating in that it is in *Rhamphorhynchus* thinly swab shaped, in *Campylognathus* it is of triangular shape. The first flight finger phalange is longer than the forearm, but not twice as long. The phalanges in *Rhamphorhynchus* from the first to the third reduce in bulk, the fourth is longer than the third. In *Campylognathus*, the first phalange is more than double the length of the forearm, the second phalange outdoes the first in length, the third however is shorter than the second and first, the fourth much shorter than the third. The carpus appears to be formed of four bones to possess a close resemblance in both species; just as in both, the proximal tarsus row is fused with the tibia (vergl. S. 216). At the pelvis in *Rhamphorhynchus*, the seat-bones are broader and tend to be fewer against the media line; also it does not show the triangular shape as in *Campylognathus*.

## Relations to reptiles and birds.

The spinal column is more reptile like than bird like, the tail is entirely reptilian in form. The vertebrae are procoele but not as in birds though they are connected with saddle joints. The skull, we observe is reptile like first of all that immovably with the fused quadrate to emphasize the existence of the specialized postfrontal, the complete bones surrounding the eye socket connecting through the jugal, furthermore the connection of the jugal with the pre- and postfrontal through ascending processes, as well as higher and edgewise temporal apertures; over the rear head region the condition of preservation of the specimen is unclear. With birds however, it is found again, like in the pterosaur, the almost seamless union of the skull bones, the pneumatic state of the extremity bones, which are also observed in certainly dinosaurs, moreover the preorbital opening and the premaxilla extend to the frontal. The location of the lower jaw at the skull lies as in birds behind the eye sockets, in *Campylognathus* it is more under the eye sockets, this seems to be the peculiar case in the Pterosaurs. Scapula and coracoid are bird like, however a furcula is missing. The hand of *Campylognathus* as in all pterosaur is peculiar and different from that of the birds. The pelvis is decidedly reptilian in form and reminds closer to that of dinosaurs, though it shows independent differences. As a significant association which cannot be interpreted with the developments in birds is the fusion of the rudimentary fibula with the tibia; while the fusion of the proximal tarsus row with the tibia reminds us of birds, the remaining part of the rear extremity are thoroughly reptilian.

The bird like adaptations of Campylognathus are like that of all pterosaurs to be interpreted as homogeneous adaptations in that the flight capacity of these reptiles likewise stipulates similar developments in bone development (Pneumatication) and single bone connections.

## Short summary of the features of Campylognathus.

Vertebrae procoel. Rib two headed, the uppermost especially robust. Tail long, surrounded by ossified tendons. Skull moderately long, almost to the snouts tip referring (13 teeth), the two foremost teeth blade shaped and curved. Quadrate rather strong triangular flat bone. Eye socket larger than a nasal opening and Preorbital opening. Nasal opening larger than latter. Lower jaw armed with 17 teeth, whereby the two foremost are especially strongly. Front third of the lower jaw flexed downwards; the short toothless tip is straight and gently rounded at the top; both halves of the symphysis are unfused. Scapula and coracoid fused. Carpus composed of four bones. Metatarpals short. Chip bone short. First flight finger phalange more than twice as long as the forearm. Flight finger phalanges of the second to the fourth decreasing in size decreasing, but the second phalange longer than the first. Sacrum formed from four vertebrae; Ileum fused with the transverse processes of the sacrum, displaced forward and behind a processes. Ischium as strong, proximally broadened, obliquely to the rear and inwardly inclined bony plate of an approximate triangular shape, with the Ileum forming the plate. Pubis unknown. Rear extremity weaker than the front extremity. Fibula as well as proximal tarsus row is fused with tibia. Distal tarsus row formed of two anklebones. Metatarsals 1-4 almost equally long, fifth metat arsal stronger and significantly shorter than the others. Number of phalanges of the toes of the first to the fifth toe amounts to 2, 3, 4, 5, 2. Second and third phalange of the third toe are fused. Terminal bone of all toes with exception of that of the fifth claw shaped.

**Munich**, in November 1894.

## End Notes.


1. Es. FRAAs. Neues Jahrbuch 1892. Bd. II. page. 87.
2. BUCKLAND, W. Proceed. Geol. Soc. London 1829 and Transactions of the geol. Soc. of London. 1835. Serie II, Vol III. page. 217.
3 H. v. MEYER, Neues Jahrbuch f. Min. etc. 1831. p. 73.
4 H. v. MEYER, Reptilien aus dem lithogr. Schiefer des Jura. Fauna der Vorwelt. Frankfurt 1860. There also a listing of the remaining Publications on Pterodactylus macronyx.
5 THEODORI, Froriep's Notizen. Nr. 623. page. 101. 1830. Isis p. 276. 1831. Bericht des naturforsch. Vereins in Bamberg. page. 17. 1852.
6 WAGNER, A. Sitzber. der k. b. Akad. d. W. 1860, S. 48. 1861, S. 520.
7 OPPEL, Württ. Jahreshefte 1856, p. 326.
8 QUENSTEDT, Württ. Jahreshefte 1858, p. 299.
9 OWEN R. British Assoc. Reports. 1858. page. 97.
10 OWEN, R. Palaeontogr. Soc. Rept. Liassic Form. 1870. Part. III, page. 41.
11 NEWTON, E. T. New Species of Pterosaurian. Philosoph. Trans. of the Royal Soc. of London. 1888. Vol. 179, page. 503.
12 Von ?αμρ????, gebogen.
13 L. v. AMMON. Rhamphorhynchus longicaudatus. Correspondenzblatt des naturw. Ver. zu Regensburg. 38. Jahrgang. 1884. page. 139.
14 H. v. MEYER. Fauna der Vorwelt. Rept. d. lithogr. Schiefers Tab. 9, Fig. 5. 1859

15 R. OWEN. Rept. Lias. Form. 1870. Part. III, page. 64 and Rept. Cretac. Form. 1851. Part. 1, Tab. 27, Fig. 5.
16 H. G. SEELEY, Ann. A. Mag. 1870. 4. Series. Vol. 6, p. 135.
17 R. OWEN. 1. c. 1870. Part. 111. page. 49.
18 Auch bei Rhamphorhynchus will H. v. MEYER Zygapophysen an Schwanzwirbeln beobachtet haben. Rept. d. lithogr. Schiefers. 1860. page. 76.
19 1. c. page. 76.
20 Mit wa sind zwei zusammengehörige Wirbel in Fig. 2 bezeichnet.
21 H. v. MEYER. Rept. d. Lithogr. Schiefers. 1860. Palaeontographica, Bd. VII. page. 79, Tab. 12.
22 H. v. MEYER. Rept. d. Lithogr. Schiefers. 1860. page. 71 and Palaeontographica Bd. VII, page. 88.
23 R. Owen. Rept. Liasic Form. 1870. Part. III. page. 77.
24 Williston. The Kansas University Quarterly. Vol. II, October 1893. No. 2. page. 80.
25 THEODORI, C., über Pterod. Knochen im Lias von Banz. I. Bericht des Bamberger Naturforsch. Vereins. Bamberg 1852.
26 Owen, R. Palaeontogr. Soc. Rept. Liasic Form. Part. 111. 1870.
27 Regarding the so-called instep bone in the remaining diagram of R. Owen 1 c Tab. 20 a marked mistake in that this bone is duplicated lying on the external (ulna) instead of on the internal (radius).
28 Newton, E. T. Philos. Trans. Roy. Soc. of London. Vol. 179. 1888. p. 503-537. - Baur, G., Mr. E. T. Newton on Pterosauria. Geol. Mag. 1889. page. 171.
29 Seeley, H. G. Quart. Journ. Geol. Soc. Vol. 36, p. 27. 1880.

## Table-Key.

### plate XIX.

**Campylognathus Zitteli.**

1/2 natural size.

| | |
|---|---|
| Sch. | = Skull. |
| Hd. r. | = Lower jaw of right side. |
| Md.l. | = Lower jaw of left side. |
| sc. R. | = Scapula of right side. |
| se. l. | = Scapula of left side. |
| cor. r. | = Coracoid of right side. |
| cor. l | = Coracoid of left side. |
| St. | = Sternum. |
| h. r. | = Humerus of right side. |
| h.l. | = Humerus of left side. |
| u. r. | = Ulna of right side. |
| r. r. | = Radius of right side. |
| u. l. | = Ulna of left side. |
| r.l. | = Radius of left side. |
| c. | = Carpus of right side. |
| mc.I. | = so called instep bone. |
| mc. v. | = Metacarpal of flight finger of right forward extremity. |
| ph. Ir, H r, IH r, IVr. | = Phalanges 1-4 of right flight fingers. |
| ph, Il, II t, IIIl, IVl. | = Phalanges 1-4 of left flight fingers. |
| wa, wb, wc, rw. | = Back vertebrae. |
| wg, wh. | = Front tail vertebrae. |
| sch. w. | = Tail spine. |
| r., r. I | = Ribs of the front rump section |
| B. | = Pelvis. |
| fe. r. | = right Femur. |
| fe. l. | = left Femur. |
| ti. r. | = right Tibia. |
| ti. l. | = left Tibia. |
| tr. | = distal Tarsus row. |
| mt. r | = Metatarsus of right rear extremity |
| mt. l. | = Metatarsus of left rear extremity |

Plate 19 on the original document was too badly damage to copy. This plate is excluded here, until a good copy can be located.