a gas-rich spiral rather than an elliptical which has little interstellar material, though given the distance of 3C48 it will be very difficult to confirm the presence of spiral structure.

It is also tempting to suggest that those quasars with strong emission lines are formed in spiral (that is, gas-rich) galaxies. In all cases, only very small amounts of gas are needed very close to the quasar to explain the line strengths seen, but then only a small amount of the available gas will be in the immediate quasar neighbourhood. BL Lac objects, which are really quasars with no emission lines and therefore probably little gas in their neighbourhood, could similarly be in the centres of elliptical galaxies (which have a low gas abundance). The late-type stellar spectrum recently found for the nebulosity around BL Lac is itself suggestive in this regard. If young stars do generally dominate the quasar stellar spectrum, this incidentally helps to explain why previous searches for starlight have failed. Most of these have looked primarily for the usual strong Ca II feature typical of a later population, which is weak or absent in the 3C48 spectrum. But much work remains to be done before this can be established; one object, however important, is hardly a statistical sample!

Another interesting, and more puzzling, result is that the redshift of the quasar determined from the galaxy starlight does not agree very well with that determined from the sharper emission lines in the quasar spectrum. While it is not unusual for the different broad emission lines to give rather different redshifts, the sharp lines are believed to arise in a more extended region and so to give a better redshift estimate. Here the sharp lines differ from the galaxy redshift by about 400 km s^{-1} while the broad hydrogen lines agree very well. It is possible that a combination of velocity flow and obscuration of the clouds shifts the sharp lines significantly, but the required shift is so large (comparable with the line widths) that it is rather difficult to explain simply.

Another surprise is simply one of observational detail. The spectra Boroson and Oke obtained for two regions of the nebulosity around 3C48 took a total of only two hours of telescope time, while others in the past have unsuccessfully devoted much longer periods of time to similar projects. A combination of an efficient spectrograph and a modern charge-coupled device as a detector has allowed them to obtain useful spectra of faint objects quickly. With such a system available one hopes, and expects, that similarly exciting discoveries will continue to be made at Palomar, and that Boroson and Oke will be able to follow up their observations by examining the nebulosity around other quasars. □

100 years ago

THE WINGS OF PTERODACTYLES

The first Pterosaurians discovered were recognised as flying animals, but were thought to be bats. As soon as their general structure became known, they were classed with the reptiles, although it was considered possible that their power of flight was due to feathers. Later their bones were mistaken for those of birds by various experienced anatomists, and others regarded them as sharing important characters with that group. Some anatomists, however, believed that the fore-limbs of pterodactyles were used for swimming rather than for flight, and this view has found supporters within the present decade. A single fortunate discovery, made a few years since, has done much to settle the question as to the wings of Pterodactyles, as well as their mode of flight, and it is the aim of the present article to place on record some of the more important facts thus brought to light.

The specimen to be described was found in 1873, near Eichstädt, Bavaria, in the same lithographic slates that have yielded *Archoeopteryx, Compsognathus,* and so many other Jurassic fossils known to fame. This specimen, which represents a new species of the genus *Rhamphorhynchus,* is in a remarkable state of preservation. The bones of the skeleton are nearly all in position, and those of both wings show very perfect impressions of *volant membranes* still attached to them. Moreover, the extremity of the long tail supported a separate vertical membrane, which was evidently used as a rudder in flight. These peculiar features are well shown in Fig. 1, which represents the fossil one-fourth the natural size.

A careful examination of this fossil shows that the patagium of the wings was a thin smooth membrane, very similar to that of modern bats. As the wings were partially folded at the time of entombment, the volant membranes were naturally contracted into folds and the surface was also marked by delicate striae. At first sight, these striae might readily be mistaken for a thin coating of hair, but on closer investigation they are seen to be minute wrinkles in the surface of the membranes, the under-side of which is exposed. The wing membranes appear to have been attached in front along the entire length of the arm, and out to the end of the elongated wing finger. From this point the outer margin curved inward and backward, to the hind foot.

Fig.3 Restoration of *Rhamphorhynchus phyllurus.*

The membrane evidently extended from the hind foot to near the base of the tail, but the exact outline of this portion cannot at present be determined. It was probably not far from the position assigned it in the restoration attempted in the cut given below, Fig. 3. The attachment of the inner margin of the membrane to the body was doubtless similar to that seen in bats and flying squirrels.

In front of the arm there was likewise a fold of the skin extending probably from near the shoulder to the wrist, as indicated in Fig.3.

The present species appears to be most nearly related to *Rhamphorhynchus Gemmingi,* von Meyer, from the same geological horizon, and near the same locality. That it is quite distinct, however, is shown, aside from the difference in size, by the complete ankylosis of the scapula and coracoid, and by the fifth digit of the hind foot being well developed, and having three phalanges. In the name *Rhamphorhynchus phyllurus,* here proposed for the species, the latter designation refers to the leaf-shaped caudal appendage, which appears to be one of its most characteristic features.

For the long delay in the description of this important European specimen, the writer can only plead *l'embarras des richesses* nearer home.

O.C. Marsh

Yale College, New Haven, March 14.

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