increase followed by a progressive decrease to the control level of total exchangeable, membrane-bound and intracellular calcium content (table 2). A significant increase in intra-cellular calcium content of portal vein was seen at 1 week after alloxan (table 2).

*Discussion.* Previously, it was reported that reactivity of alloxan diabetic rat aortae to both specific and nonspecific vasoactive agents (i.e., norepinephrine, angiotensin and potassium chloride) progressively decreased as the diabetic symptoms, reflected by sequential metabolic abnormalities, advanced[5]. Furthermore, it was also demonstrated that the fast and slow components in the contractile responses of norepinephrine, angiotensin and potassium were markedly attenuated in these alloxan diabetic rat aortic strips[5]. It is known that the initial fast components of these contractile responses utilize mainly intracellular calcium stores, whereas the maintained slow, tonic components are associated with an increased calcium influx[14]. Based on these observations, it was postulated that decreased aortic reactivity to the vasoactive agents could be due to an alteration in calcium regulation in aortic smooth muscle excised from alloxan diabetic rats that involves both sources of ionic calcium. Since the present results indicate increased calcium uptake, and increased cellular and membrane calcium content in diabetic aorta at 8 weeks, one might expect increased reactivity to vasoactive agents. However, we reported that aortic reactivity to vasoactive agents, that utilize both intra- and extracellular sources of calcium, was markedly attenuated[5]. These findings lead us to suggest that the affinity for calcium binding on membrane and intracellular sites is probably increased in arteries of the diabetic rats. This bound calcium is probably resistant to release by vasoactive agents, which could result in a lowering of the free cytoplasmic calcium available to the contractile proteins. It is unlikely that the observed changes in calcium content of aortae from diabetic rats are due to structural alterations in the membranes, since a recent study[15] demonstrated that aortic smooth muscle cells of alloxan-treated rats (8 weeks after treatment) did not reveal any structural abnormalities either at the membrane or at other subcellular sites.

In contrast to aorta, reactivity of diabetic portal veins to vasoactive agents was not modified when compared to that of the saline controls[5]. In the present study, $Ca^{2+}$ uptake and distribution in 4 and 8 week diabetic portal veins was found to be unaltered. Since both reactivity[5] and $Ca^{2+}$ distribution of diabetic and control portal veins were similar at 4 and 8 weeks, it is probable that the $Ca^{2+}$ kinetics and affinity for its binding sites on the membranes and intracellular loci is not altered in alloxan diabetic venous smooth muscle of rats. As noted here in the result section, the amplitudes of the average spontaneous contractions of diabetic portal veins were greater than the saline control portal veins. One might be tempted to conclude that the initial increase in $Ca^{2+}$ uptake and intracellular $Ca^{2+}$, observed after 1 week of alloxan treatment, might account for the increased resting tone of the portal veins. Such a mechanism, however, appears unlikely in view of the fact that the increases in $Ca^{2+}$ concentration were not maintained at 4 and 8 weeks when the spontaneous activity was greatest. It is thus difficult, at the present time, to account for the progressive increase in venous tone in terms of changes in $Ca^{2+}$ kinetics.

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## Metabolism – weight relationship in some small nonpasserine birds

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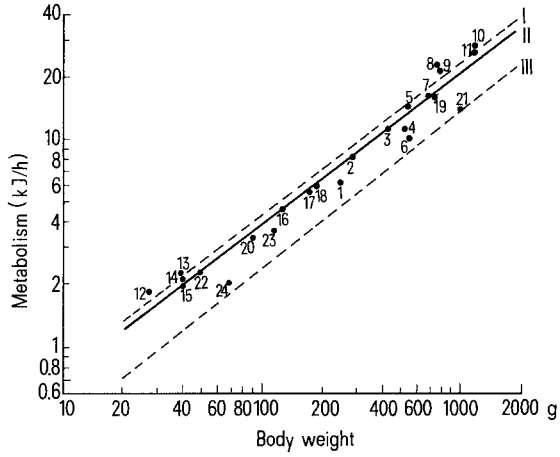
*Summary.* The metabolism – weight relationship 24 different nonpasserine birds follows the equation $M = 0.138\ W^{0.716}$. No pronounced differences could be found, relating to the metabolic rate per unit body weight, between these birds and representatives of the order Passeriformes.

A comprehensive analysis of the thermoregulatory process requires adequate knowledge of the levels of heat production. In most animals the basal metabolic rate varies with a fractional power of body weight. The exact value of the exponent and the complete equation for the avian basal metabolism – weight relationship appear to differ between the order Passeriformes and the other avian orders (Nonpasseres, nonpasserine birds). Previous examinations have established a higher basal metabolism of the Passeriformes. In order to examine this, we investigated the metabolism of 24 varied, relatively small (see below) representatives of the nonpasserines of 9 orders, using a standardized procedure.

*Materials and methods.* The bird species examined[1] are listed in the table. No previous examinations have been

Number, systematic order, body weight and basal metabolic rate (BMR) of some nonpasserine birds

| Order and representatives | Number | Body weight (g) | BMR (kJ/h) |
|---|---|---|---|
| Anseriformes | | | |
| 1. Green-winged teal *Anas crecca* | 1 | 250 | 6.00 |
| 2. Garganey teal *Anas querquedula* | 1 | 289 | 8.04 |
| 3. Ferruginous duck *Aythya nyroca* | 1 | 440 | 11.78 |
| 4. European wigeon *Anas penelope* | 1 | 539 | 11.29 |
| 5. Northern shoveler *Anas clypeata* | 1 | 554 | 13.96 |
| 6. Tufted duck *Aythya fuligula* | 1 | 574 | 9.73 |
| 7. Pintail *Anas acuta* | 1 | 721 | 15.71 |
| 8. Gadwall *Anas strepera* | 1 | 791 | 22.33 |
| 9. Common pochard *Aythya ferina* | 1 | 816 | 20.94 |
| 10. Mallard *Anas plathyrhynchos* | 1 | 1236 | 27.28 |
| 11. Red-crested pochard *Netta rufina* | 1 | 1237 | 25.56 |
| Psittaciformes | | | |
| 12. Blue-crowned hanging parrot *Loriculus galgulus* | 4 | 27 | 1.86 |
| 13. Budgerigar *Melopsittacus undulatus* | 4 | 39 | 2.24 |
| 14. Turquise parrot *Neophema pulchella* | 4 | 40 | 2.09 |
| 15. Bourke's parrot *Neophema bourkii* | 4 | 40 | 1.94 |
| Cuculiformes | | | |
| 16. Common cuckoo *Cuculus canorus* | 1 | 128 | 4.52 |
| 17. Senegal coucal *Centropus senegalensis* | 1 | 175 | 5.43 |
| 18. Common koel *Eudynamys scolopacea* | 1 | 188 | 5.92 |
| Gruiformes | | | |
| 19. Common coot *Fulica atra* | 1 | 754 | 15.71 |
| Charadriiformes | | | |
| 20. Green sandpiper *Tringa ochropus* | 1 | 90 | 3.32 |
| Falconiformes | | | |
| 21. Common buzzard[6] *Buteo buteo* | 3 | 1012 | 13.52 |
| Galliformes | | | |
| 22. Blue-breasted quail *Coturnix chinensis* | 4 | 49 | 2.26 |
| 23. Japanese quail[7] *Coturnix c. japonica* | > 50 | 115 | 3.52 |
| Coraciiformes | | | |
| 24. Common hoopoe *Upupa epops* | 1 | 67 | 1.99 |




Basal metabolism as a function of body weight in the nonpasserine birds examined. Each value represents the average of at least 3 series of measurements, each taken over 12 h under thermoneutral conditions during the rest period (at night). Weight-regression line I: Dawson and Hudson[4], passerines; II: present study on nonpasserines; III: Aschoff and Pohl[5], nonpasserines ($M = 0.081\ W^{0.734}$). For the other equations see text, for the numbers of the points see table.

made of the majority of the species. The basal metabolism of each species was determined during a period of at least 3 nights (each of 12 h) at a constant environmental temperature between 20–25 °C (thermoneutral zone). Measuring instruments: Hartmann & Braun Magnos 2T and Uras 2T. (For more details see Prinzinger[2,3].)

*Results and discussion.* (Table and figure.) The following correlation between body weight and basal metabolism was established for the species examined: $M = 0.138\ W^{0.716}$ (M = metabolism in kJ/h and W = b.wt in g, see figure, II). The weight-regression exponent corresponds to the results of examinations made by Dawson and Hudson[4] (0.720) and by Aschoff and Pohl[5] (0.734 and 0.726). However, we found considerable differences in the absolute value of the basal metabolism. According to previous examinations, nonpasserine birds should show a lower metabolic rate per unit body weight in comparison with Passeriformes. In the weight class that we examined this difference is not pronounced, or not recognizable. There is practically no difference between Aschoff and Pohl's results on Passeriformes from 8.5 to 515 g b.wt ($M = 0.133\ W^{0.726}$) and ours (on nonpasserine birds from 27 to 1237 g b.wt). Both equations are practically congruent. Compared to Dawson and Hudson's data ($M = 0.094\ W^{0.72}$ for nonpasserines) our values are considerably higher and almost reach the values for the Passeriformes ($M = 0.155\ W^{0.72}$, see also figure, I, and for Aschoff and Pohl's data on nonpasserines, III). It may thus be assumed that the great differences observed in previous examinations result from the fact that most of the small birds (< 100 g) for which metabolic data were available are members of the order Passeriformes, whereas most of the larger species are members of the nonpasserine orders. Those representatives of the 2 systematic groups which weigh the same do not show any pronounced differences. Our own results[2] on various larger Passeriformes (*Pica pica,* 208 g, 5.64 kJ/h; *Corvus monedula,* 193 g, 6.01 kJ/h; *Corvus corone* 360 g, 9.05 kJ/h) support this observation: their values for basal metabolism are in the immediate field, or rather, directly on the regression lines obtained for the nonpasserines.

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