A study of the distribution of dopamine in the brain has shown that the amine is predominantly localized in the corpus striatum of the hemispheres. For example the caudate nucleus of the dog contains about 6·5 µg dopamine/g tissue, representing more than 80% of the total brain dopamine. The localization of dopamine in brain differs largely from that of noradrenaline, as shown by simultaneous fluorimetric determinations of the two amines. Noradrenaline appears to be detectable in all parts of the brain, though in varying concentrations. The highest amounts are found in the diencephalon, mesencephalon, and medulla oblongata, where very little dopamine can be detected. On the other hand the sites with the highest dopamine content contain little noradrenaline. These data on the distribution of noradrenaline in brain are essentially in agreement with earlier observations[4,5].

The amount of dopamine in the peripheral organs examined, i.e. heart, lung, spleen, liver, and kidney, is very small except in some organs of the two ruminants investigated, namely, cow and sheep. In the lung and the capsule of the liver of the cow and the lung of the sheep high values have been recorded, i.e.11, 5, and 4 µg/g respectively. Appreciable amounts of dopamine are also present in the heart and spleen of both species. These observations in the cow and sheep confirm and extend earlier findings[6,7].

The presence of these large amounts of dopamine in ruminants has now led to the discovery of a hitherto unknown type of chromaffin cells now being investigated by FALCK and HILLARP[8]. The occurrence of these cells appears to be closely related to the presence of dopamine in tissues other than brain, where no such cells have been seen.

In preliminary experiments with Amphibia (*Rana temporaria* and *Bufo vulgaris*) it was found that dopamine contributes very little to the total catechol amine content. The principal catechol amine in both brain and peripheral organs is adrenaline.

The distribution of dopamine in brain and other tissues indicates that it may have a function of its own and not only serve as an intermediate in the formation of noradrenaline and adrenaline. The results favour the assumption that dopamine is concerned with the function of the corpus striatum and thus with the control of motor function. This view is supported by the fact that drugs which influence the dopamine content of the corpus striatum also produce disturbances in motor activity. As is well known, reserpine produces motor hypoactivity and may also cause various components of Parkinson's syndrome. This drug has been found to deplete the corpus striatum of dopamine, the time course being about the same as for noradrenaline[9]. Excess of dopamine in brain produced by administration of DOPA is accompanied by motor hyperactivity[10].

The results of this investigation will be published in detail elsewhere.

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Department of Pharmacology, University of Lund (Sweden), August 27, 1958.

Zusammenfassung

Dopamin kommt im Gehirn aller untersuchten Säugetiere ausschliesslich im Corpus striatum vor. In andern Organen der untersuchten Tierarten ist der Dopamingehalt sehr gering, mit Ausnahme einzelner Organe bei Schafen und Kühen. Die Veränderung der Motorik von Versuchstieren durch Arzneimittel, welche den Dopamingehalt der Basalganglien beeinflussen, und die Lokalisation von Dopamin im Gehirn sprechen dafür, dass Dopamin für die Funktion der Basalganglien von Bedeutung ist.

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Spawning in Coelenterates

Recently, I re-examined the spawning of *Hydractinia echinata*, originally studied by BALLARD[1], to compare it with that of the Japanese coelenterates; *H. epiconcha*[2] and *Spirocodon saltatrix*[3].

As mentioned by BALLARD, the male and female gonophores will discharge if illuminated after a sojourn in darkness. According to him, photosensitive substances, which initiate the maturation process, are accumulated during the dark period. In *H. echinata*, I find that 1–6 h in darkness are required to induce spawning by re-illumination, but longer periods are not favourable (Table). Since a longer period in light before darkness increases the percentage of animals which spawn, it appears that the animals mature during the illumination, although the final stages of maturation and discharge do not occur until the animals are subjected to one further period in darkness and one in light. It is suggested that the earlier illumination advances changes associated with maturation to a certain level, after which the breakdown of photosensitive substances, accumulated during the dark, becomes effective provided a threshold concentration is attained. This hypothesis is supported by the fact that periods of 5–10 s illumination at 10–20 min intervals during a 3 h dark period greatly reduce the number of animals which spawn on subsequent illumination. The darkness can thus be regarded as the period during which the photosensitivity is increased.

The re-illumination need not necessarily be continued until shedding occurs. In general, the brighter the illumination, the shorter the exposure period that is necessary to induce responsiveness. The Bunsen-Roscoe Law does not hold here, for in dimmer light, the value of the product (intensity X time of exposure) that is required to induce spawning in a given percentage of cases is greater.

Histological examination reveals no detectable change in the gonophores until they are subjected to light for the second time, after which both maturation divisions occur and they eventually discharge.

Thus spawning is controlled by at least three factors, two conditioning (the earlier illumination and the darkness) and one triggering mechanism (the later illumination).

The effect of Ca- and Mg-free sea water is also interesting. No change in the number of gonophores which spawn is caused by lack of Mg, though spawning may be slightly delayed. Lack of Ca during the darkness, or just before the spawning is due to start, inhibits the reaction. No effect is seen when gonophores are immersed in Ca-free sea water for 30 min after re-illumination.

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	Light	Dark	Light
		■	
H. epiconcha . . .	Gametogenesis including maturation division Medusoid formation *Ca-independent*	Spawning *Ca-dependent*	
H. echinata . . .	Gametogenesis excluding maturation division	Photosensitization for completion of maturation division *Ca-dependent*	Gametogenesis completion *Ca-independent* Spawning *Ca-dependent*

Schematic comparison of spawning process in relation to photic and ionic conditions between *H. epiconcha* and *H. echinata*

In *H. epiconcha*, darkness alone triggers off the spawning proper (membrane dissolution and pulsation). Clear antagonism between Ca- and Mg-ions exists[4]. Sea water lacking Ca, or with excess Mg, inhibits the spawning, whilst lack of Mg or excess Ca elicits spawning without the period of darkness. Gonophore development and gametogenesis proceed in light without Ca-ions.

The similar reactions of both species to light and ions are shown schematically in the Figure. Thus in both cases the process of maturation (including the maturation divisions) depends on light, but is independent of the presence of Ca-ions. The darkness, on the other hand, stimulates spawning in one case (*H. epiconcha*) and increases photosensitivity in the other (*H. echinata*). In both, events in darkness are profoundly influenced by Ca-ions, but in the former, Mg-ions are inhibitory. Again, discharge of germ cells when triggered either by the dark (*H. epiconcha*) or the light (*H. echinata*) is dependent on Ca-ions.

	Maturation	Spawning
Spirocodon saltatrix . .	dark	independent of illumination
Hydractinia epiconcha .	light	dark
Hydractinia echinata . .	partly in light	dark followed by light

Spirocodon differs in that gametogenesis begins in darkness and spawning follows automatically in due course. The part played by Ca- and Mg-ions is unknown.

The different ways in which light affects the spawning of hydrozoans are summarized as above.

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Résumé

La ponte de *H. echinata* est influencée par la lumière, qui est nécessaire pendant deux périodes: d'abord pendant la gamétogenèse et plus tard (après une période d'obscurité) pour déclencher la maturation finale et la ponte.

L'effet de la lumière pendant la deuxième période ne suit pas la règle de Bunsen-Roscoe. *H. echinata* est comparée, en ce qui concerne l'action des divers facteurs, avec *Spirocodon* et *H. epiconcha*. La signification des ions de Ca et Mg est examinée.

Some Observations on the Control of the Tongue Muscles

The problem of the proprioceptive innervation of the tongue has for a long time attracted attention, no doubt for the reason that the hypoglossal nerve does not have a posterior root. The major problem, usually attacked with morphological methods only, has been whether there are any muscle spindles in the tongue and – if they are present – by which nerve and posterior root their connection with the central nervous system is established. Ear-

Effect of first illumination period and darkness on spawning. The figures for each experiment are percentages of gonophores in a given batch which spawned

Conditions		♂						♀				
		Serial No. of experiment						Serial No. of experiment				
Illumination (h)	Darkness (h)	1	2	3	4	5	6	1	2	3	4	5
18	$^{1}/_{4}$	0	0									
18	$^{1}/_{2}$	0	20	2	0					1		
18	1	11	74					7	32	30		
18	2	36	82					57	64			
18—15	3		99	43	52	76	33	40	60	39	83	78
12	6			19						36		
0	18			0	2	12	11			3	12	2
Number of isolated gonophores used in each batch		120	100	70	90	25	160	40	25	70	30	50

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[4] M. YOSHIDA, unpublished.