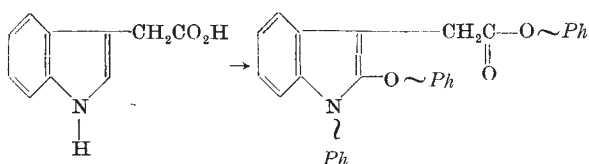


We may now consider the role of the natural plant growth regulator, indole-3-acetic acid, in the above light. There are three possible high-energy bonds.



Of these, only the enol phosphate seems likely to be generated directly from inorganic phosphate and extracellularly-added indole-3-acetic acid. The carboxyl-phosphate and the *N*-phosphate, in such circumstances, could probably not be formed except by transphosphorylation from adenosine triphosphate, which, however, would not result in the generation of energy-rich phosphate. But, if indole-3-acetic acid is synthesized from tryptophane in plants, the energy-rich carboxyl-phosphate bond might be generated by oxidative decarboxylation of a possible intermediate indole-pyruvic acid.

Whatever the mechanism involved, the point we wish to make is that the metabolism of indole-3-acetic acid or its precursors may generate energy-rich phosphate bonds, and that this access of energy may be the prime factor in the initiation of the growth response.

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¹ *Plant Physiol.*, **24**, 358 (1949).

² *J. Sci. Food Agric.*, **2**, (3), 101 (1951).

³ Baker, "Tautomerism", 107 and 154.

⁴ *Biochem. J.*, **36**, 737 (1942).

⁵ "Plant Biochemistry", 458 (1950).

Importance of the 'Counter Current Principle' for the Oxygen Uptake in Fishes

ACCORDING to van Dam¹, the high utilization of oxygen in fishes is due, among other things,

We carried out some experiments with tench of about 16 gm., narcotized with 0.7 per cent ethyl urethane until the movements of the opercula had just stopped. The mouth of the fish was tied to a piece of rubber tubing. We verified that no water could pass between lips and tubing by suspending some India ink in the water passing through the latter.

Water was pumped through the tubing by means of a small pump, driven by a synchronous motor with a variable retarding attachment. The direction of the water stream could be reversed at any moment by starting the motor in the opposite direction.

At one side of the fish the gills were put out of action by pressing the operculum against the body wall. The volume of water driven along the gills of the other half of the body was exactly known. At the beginning of each experiment we worked with opposite currents, and regulated the velocity of the water stream in such a way that the utilization of oxygen amounted to 50–70 per cent. Afterwards the direction of the water current was reversed, and the utilization determined again. Repeatedly we verified at a magnification of about twenty times that the abnormal direction of the water stream caused no observable change in the position of the gill lamellæ. Therefore, the results of our experiments cannot be ascribed to a modification of the area of contact between water and gills. Finally, in some cases, we returned to opposite currents at the end of the experiment, and once more determined the utilization. The results of the experiments are summarized in the accompanying table.

The variation among individual experiments is considerable. Nevertheless, the difference in utilization during opposite currents and during parallel currents is quite evident. Averaging over all the experiments, we find for thirty-two cases of opposite currents a mean utilization of 51 per cent, and on the other hand for twenty-five cases of parallel currents a mean utilization of 9 per cent. In other words, these experiments show that the 'counter current principle' is of high importance for the efficiency of

Exp. No.	Weight of fish (gm.)	Velocity of water stream (c.c./sec.)	Temp. (° C.)	Utilization of oxygen (per cent)		
				opp. dir.	same dir.	opp. dir.
1	13.2	0.16	21	28	3; 5	17
2	19.3	0.16	18	88	28; 17	87
3	19.3	0.16	16	57	6; 5	76
4	19.3	0.16	16	75	18; 13	50
5	19.3	0.16	16	69	4	
6a*	19.3	0.16	16	88; 89; 92		
6b					4; 6; 5; 3	
6c						26; 31; 31; 33
6d						53; 47; 44; 42
7	16.1	0.16	18	36; 43	1; 5	
8	19.3	0.16	18	38; 34	6; 3	
9	16.1	0.16	18	54; 46	21; 4	
10	16.1	0.15	18	39; 31	6; 8	
11	16.1	0.15	18	50; 61	13; 16	
12	16.1	0.15	17	44; 45	19; 15	

* Expt. 6a, b, c and d were carried out on different days.

to the circumstance that in the gills water and blood flow in opposite directions. The question rises whether this hypothesis can be verified experimentally. The direction of the blood stream in the gill lamellæ is not liable to changes; that of the water current, however, can be reversed.

the fish gill, and no doubt for that of other gills as well.

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University, Groningen, Aug. 8.

¹ Dam, J. van, "On the Utilization of Oxygen", etc., thesis, Groningen (1938).