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WORLD NATURAL RESOURCES[1]

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INTRODUCTION

It will, I think, be obvious that a subject as broad as that assigned to me to-night can not be fully treated in the time at my disposal. I therefore propose in the first place to review, very briefly, the fundamental resources that nature has placed at man's disposal; subsequently I shall discuss, at somewhat greater length, the adequacy or inadequacy of those resources to provide the requisites for food, clothing, shelter, heat and power.

It will not be sufficient, however, to consider the world's natural resources from the point of view of present methods of utilization alone. Resources in which we were not interested yesterday are of vital importance to-day; the useless or inert of to-day may to-morrow, through the contributions of science, profoundly affect the welfare of the human race.

To take only one example of how science and technology have made available a natural resource that probably would not even have been listed as such fifty years ago, let us consider the nitrogen of the atmosphere. Our knowledge of nitrogen as a plant and animal food goes back only about one hundred years. Research during the latter part of the nineteenth century demonstrated that the ultimate source of nitrogen was the air, from which it was derived through the action of micro-organisms in the soil, and atmospheric electricity. These, however, were natural agencies, over which man had little control, and in order to restore the depleted nitrogen of the soil he was dependent upon the application of animal wastes, nitrates obtained from certain natural deposits, and ammonia recovered as a by-product in the cooking of

[1] Paper presented June 27, 1938, before the American Association for the Advancement of Science, in the series on Science and Society.

lary network is a problem of much interest, and the discovery of Wislocki and Campbell at once raises the question whether or not the condition in the opossum is one characteristic of marsupials in general and of monotremes. It is to be hoped that the matter will soon be investigated where such animals are freely available.

Meanwhile it has been possible to examine sections of the cerebellar cortex and of the cervical region of the spinal cord of a specimen of *Macropus bennetti*. The specimen had been in formalin for some years, so that injection methods were not applicable, but a variety of stains were tried, of which that of Perdrau yielded

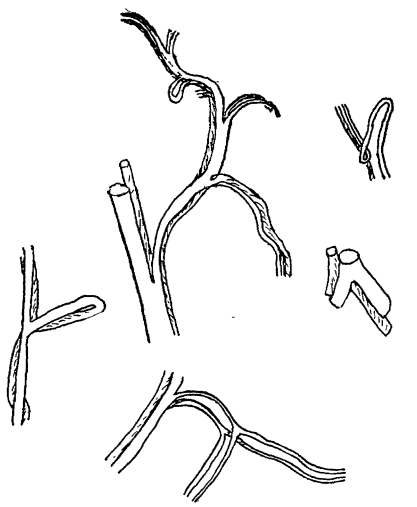

FIG. 1. Drawings of vessels in a section 150 micra thick of the spinal cord of *Macropus bennetti*, stained by the method of Perdrau.

the most useful, though not very good, preparations. These show clearly that the disposition of the vessels in the tissues examined is largely, and probably entirely, the same as that in the opossum. The vessels run in closely associated pairs, the one member usually noticeably larger than the other. Each member of a pair branches when the other does. The branches end in simple loops and there is no evidence of anastomosis. Thus it appears probable that the central nervous system of the kangaroo is like that of the opossum in being vascularized entirely by much branched, but strictly non-anastomosing, looped blood vessels. The fact that the two marsupials examined, representing different superfamilies and different geographical areas, both show this character suggests the likelihood that it is a feature of the Metatheria in general.

Scharrer[6] has emphasized the end-arterial character of the arteries entering the brain-substance of the opossum, but has pointed out that the branches of adjacent pairs of vessels interlace in such a fashion that any given mass of tissue is supplied by branches from several of them. The close association between the two members of a pair throughout their length does not appear to have been discussed, however. Mossman[7] has shown that in the placenta of the rabbit the maternal and foetal vessels run parallel to each other in opposite directions, so that as fetal blood runs through the placental capillaries it comes into association with maternal blood of increasing purity and may be in approximate equilibrium with the arterial blood of the mother when it reaches the umbilical vein. It seems possible that a somewhat analogous situation exists in the central nervous system which is vascularized by capillary loops. A spongy reticulum permits a more or less free distribution of blood in all directions through the tissues, but when the supply is entirely by closed, non-anastomosing loops, the venous limb of each loop would tend to carry less oxygen and nutriment and more waste products than the arterial limb. If the limbs were spread widely apart, the tissue immediately surrounding each venous limb would thus be supplied with blood poorer than that supplying the tissue surrounding each arterial limb. The two limbs being so closely associated as they are, however, the blood flowing along the venous limb and tending to decrease in purity is associated with blood of increasingly arterial character in the arterial limb. Thus a relatively uniform condition of the blood throughout the capillary loop may be maintained and every part of the tissue through which the loop passes is more likely to have an adequate supply. Such an arrangement would be of obvious value in the salamander brain, where the loops are simple and there is no extensive interlacing of branches, and would doubtless be equally important in the nervous system of the warm-blooded animal, with its greater metabolic requirements.

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[6] E. Scharrer, *Zeits. f. d. ges. Neurol. u. Psychiatrie*, 162: 401–410, 1938.

[7] H. W. Mossman, *Am. Jour. Anat.*, 37: 433–497, 1926.

BOOKS RECEIVED

BRADLEY, JOHN H. *Patterns of Survival; An Anatomy of Life.* Pp. 223. Macmillan. $2.25.

CAYLEY, NEVILLE W. *Australian Parrots; Their Habits in the Field and Aviary.* Pp. xxviii + 332. Illustrated. Angus and Robertson, Sydney, Australia. 12/6.

HAGGARD, HOWARD W. *The Science of Health and Disease; A Textbook of Physiology and Hygiene.* Pp. xiii + 594. 10 plates. 89 figures. Harper. $3.00.

MILLIKAN, ROBERT A., HENRY G. GALE and CHARLES W. EDWARDS. *A Manual of Experiments; To Accompany "A First Course in Physics for Colleges."* Revised edition. Pp. v + 221. 134 figures. Ginn. $1.10.

MOON, TRUMAN J. and PAUL B. MANN. *Biology; A Revision of "Biology for Beginners."* Pp. x + 866 + c. 405 figures. Holt. $2.00.

TIFFANY, LEWIS H. *Algae; The Grass of Many Waters.* Pp. xiii + 171. 41 plates. 12 figures. Charles C Thomas. $3.50.