increased temperature in the contralateral half of the body. This elevation in temperature of the affected extremities has since been noted repeatedly in clinical cases of cortical hemiplegia, but the vascular changes have usually been attributed to atrophy or to paralysis and disuse. Langworthy and Richter[9] have found two regions adjacent to the motor area of cats which, when stimulated, produced a change in sweating as measured by galvanic skin response. Stimulation of no other area of the cortex produced such a change, but faradization of the cortico-spinal, cortico-pontine and rubro-spinal and vestibulo-spinal tracts all resulted in characteristic galvanic skin responses.

A human case showing unilateral vasomotor disturbance has recently been reported.[10] The patient had a tumor of the right premotor area which produced symptoms of paresis and Jacksonian attacks confined to the left *arm* alone, but there was increased redness, heat and sweating over the entire left side of the body, together with inconstant edema of the left hand.

Recently, in the course of some experiments on the effect of extirpation of the premotor cortex (area 6 of Brodmann) on the motor performance of subhuman primates,[11] a difference in the skin temperature of the extremities on the two sides was observed, following unilateral ablation of the premotor cortex. On further investigation of this phenomenon it was found that the palm and sole of the extremities contralateral to the lesion were definitely colder to touch than those of the ipsilateral side. This difference in skin temperature, measured by a Leeds-Northrup temperature recording apparatus, varied between 2 and 4 degrees F. A very transient edema lasting 24 to 48 hours accompanied this change, which was also transitory, but lasted one to two months after operation. In one chimpanzee the affected extremity showed a very evident alteration in the texture of the skin which became drier and thicker than on the normal side. These changes of temperature and skin consistency were present after the temporary paresis had disappeared, and this could not therefore be attributed to disuse.

In order to analyze this vasomotor phenomenon in greater detail the following observations have been made. When a normal animal is subjected to rapid alterations in the temperature of its surroundings, there is an immediate reflex alteration of the skin temperature of the soles and palms which is equal on the two sides. After unilateral extirpation of certain portions of the frontal lobe, abrupt cooling gives rise to *vasoconstriction,* which occurs equally and simultaneously in both feet as it does in a normal monkey; but on heating *vasodilatation occurs very slowly in the foot opposite to the operated cortex,* whereas in the ipsilateral foot it is prompt and normal in character. This alteration in the vasodilator mechanism is marked immediately after operation, but disappears slowly in the course of several weeks. Sweating is bilaterally equal, as determined by the starch iodine method of Guttmann,[12] only when the temperature of the two extremities happens to be the same.

The following manifestations related to the parasympathetic systems are also associated with disturbance of the premotor cortex: (1) stimulation of the premotor area in monkeys results in slowing of the heart, and eventually in irregularity of heart beat; (2) stimulation of the premotor area also produces an increase in intestinal peristalsis;[13] (3) bilateral extirpation of the premotor area has been followed in monkeys by intestinal stasis and in several instances by intussusception.[13]

CONCLUSIONS

The premotor area of the cerebral cortex directly influences the autonomic nervous system and in particular the vasomotor mechanism, since lesions confined to this area, both in man and in subhuman primates, result in: (1) alterations in skin temperature in the contralateral side of the body; (2) alterations in color and texture of the skin; (3) occasional and inconstant edema of the contralateral extremities; and stimulation of this region causes (4) changes in heart rate, and (5) alterations in intestinal motility.

MARGARET A. KENNARD

THE PRESENCE OF NITRIFYING BACTERIA IN DEEP SEAS[1]

PROBABLY no other phase of marine bacteriology has attracted as much attention as the process of oxidation of ammonium salts, which results in the formation of nitrite, followed by the oxidation of the nitrite to nitrate. Some investigators believed that the cycle of nitrogen in the sea is practically similar

[9] O. R. Langworthy and C. P. Richter, "The Influence of Efferent Cerebral Pathways upon the Sympathetic Nervous System," *Brain,* 53: 178, 1930.

[10] Margaret A. Kennard, H. R. Viets and J. F. Fulton, "The Syndrome of the Premotor Cortex in Man; Forced Grasping, Spasticity and Vasomotor Disturbance," *Brain,* 57: (in press), 1934.

[11] J. F. Fulton and Margaret A. Kennard, "A Study of Flaccid and Spastic Paralyses Produced by Lesions of the Cerebral Cortex in Primates," Research Publ. Ass. Res. Nerv. Ment. Dis., 13: (in press), 1934.

[12] L. Guttmann, "Die Schweisssekretion des Menschen in ihren Beziehungen zum Nervensystem," *Zeits. f. ges. Neurol. Psychiat.,* 135: 1, 1931.

[13] J. W. Watts and J. F. Fulton, "Intussusception—the Relation of the Cerebral Cortex to Intestinal Motility in the Monkey." *New Eng. Jour. Med.,* 210 (to appear), 1934.

[1] Contribution No. 44 of the Woods Hole Oceanographic Institution and Journal Series Paper, New Jersey Agricultural Experiment Station, New Brunswick, N. J.

to that in land soils, while others were convinced that nitrates are not formed in the sea itself but are brought into the sea from the atmosphere or by land drainage; still others denied altogether the bacterial nature of the process and suggested its origin by electric discharges or by photochemical processes.

The work of Brandt, Thomsen, Issatchenko and Lipman led, however, to a definite conclusion that, while nitrifying bacteria may be absent in sea water, they are present abundantly in the sea bottom. Issatchenko[2] demonstrated the presence of these organisms in the North Arctic Ocean and in the Sea of Azov; he found them also in the Black Sea, but only in the bottom material close to shore. Similar results were obtained at the Woods Hole Oceanographic Institution,[3] for samples taken from the Gulf of Maine and from George's Bank; the method used for demonstrating the presence of these organisms was found to be of primary importance.

One of the major criticisms[4] directed against the findings of the nitrifying bacteria in the sea only along the littoral zone was that they are not normal sea inhabitants, but that they are rather a result of introduction from land soils by means of drainage waters. In order to meet this criticism, samples of sea-bottom material were obtained on the oceanographic vessel, *Atlantis,* from deep seas, north of Bermuda. The greatest depth of the water was 4,742 meters. The methods used for obtaining the samples of sea bottom under sterile conditions as well as for determining the presence of the specific organisms are described in detail elsewhere.[5] Active formation of nitrite, in an ammonium sulfate medium, was obtained at room temperature in 7 days, in the case of some samples, and in 27 days in all samples, as shown in Table I. It may be of interest to add that when cultures from stations 1730 and 1736 were incubated at 8° C., active nitrite formation from ammonium salt was obtained in 46 days.

TABLE I

Station No.	Depth of sea bottom, meters	Location		Nitrite-formation in days*				
		Lat.	Long.	7	18	27	36	90
1725	165	40°01′N	70°04′	0	0	tr	0	++
1726	643	39°51′	69°59′	tr	tr	+	+	++
1730	3,220	38°47′	69°11′	tr	+	+	+	+
1736	4,742	36°50′	68°52′	tr	+	+	++	++

* 0 = negative; tr = trace of nitrite; + = positive nitrite test; ++ = abundant nitrite formation.

[2] B. Issatchenko, "Sur la nitrification dans les mers." *Compt. Rend. Acad. Sci.,* 182: 185–186, 1926.

[3] S. A. Waksman, M. Hotchkiss and C. L. Carey. "Marine Bacteria and Their Rôle in the Cycle of Life in the Sea. II. Bacteria Concerned in the Cycle of Nitrogen in the Sea." *Biol. Bull.,* 65: 137–167, 1933.

[4] H. H. Gran, "Bacteria of the Ocean and Their Nutrition." *Naturen* (Bergen), 27: 33, 1903.

[5] Waksman, Hotchkiss and Carey, *loc. cit.*

Although the presence of nitrite-forming bacteria was demonstrated in practically all the samples of marine-bottom material, no matter at what depth and at what distance from shore, the formation of nitrate could not be demonstrated in the cultures. This is due to the fact that the method of testing for nitrate is much less sensitive than that for nitrite, and also because the nitrate-forming organisms develop much later. In the case of the cultures of nitrifying bacteria obtained in 1932 from the bottom deposits taken off Gay Head, it took from 42 days to nearly three months' incubation of the cultures before the nitrate-forming bacteria could be demonstrated. However, once they began to develop in the medium, further transfers resulted in active production of nitrate within a week or two.

These results prove beyond any doubt that the process of nitrification in the sea is brought about by bacteria which are native inhabitants of the sea bottom and are not merely contaminations from land.

CORNELIA L. CAREY
BARNARD COLLEGE, COLUMBIA UNIVERSITY
SELMAN A. WAKSMAN
NEW JERSEY AGRICULTURAL
EXPERIMENT STATION

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