tion) all systematic (chiefly generic) names published as new in the foregoing works, but to leave them as *available* as of the dates when they were later adopted by authors whose nomenclatorial status is unquestioned by zoologists; thus, a *modus operandi* is suggested to solve in a practical way the impasse which has existed for about twenty years in the views respecting the use of the words "binary" and "binomial" and while neither side concedes the principle it supports, both sides unite on another principle, namely, that the important end in view is to obtain, not to delay, results, and that the "plenary power," used judiciously and discreetly, offers us a practical method to solve the problems upon which there is such conscientious difference of opinion as to interpretation that concensus of opinion seems hopeless.

The secretary is fully persuaded that the application of the rules to the foregoing publications will continue to result in greater confusion than uniformity and he proposes at the expiration of the proper time (one year) to recommend to the commission the adoption of Commissioner Jordan's proposition.

Zoologists interested in this proposition, *pro* or *con,* are cordially invited to present their views in writing to any member of the commission so that they can be given due consideration when this proposition comes to vote (approximately October 1, 1923). Views, *pro* or *con,* which reach the secretary prior to September 1, 1923, will be manifolded and submitted to the commission prior to the final vote.

C. W. STILES,
Secretary to Commission

SPECIAL ARTICLES

THE ORGANIZATION OF THE NERVOUS MECHANISM OF RESPIRATION

WE have been accumulating experimental data on the nervous mcehanism of respiration for some years past, but these results have been for the most part presented in preliminary notes only.[1] Circumstances have arisen which make it seem probable that the publication of the full experimental data must be still further delayed. We wish, therefore, to present a brief summary of our general conclusions at this time.

Gad stated that the nervous mechanism of respiration extended from the facial nerve to the lumbar plexus. We must, in all probability, enlarge the field to include the fifth cranial nerve. Any statement of the organization of this mechanism must take account of all the pertinent elements found in this rather extensive region.

The primitive nervous mechanism for the control of respiratory movements in vertebrates has its central representation in the medulla oblongata. Against Trevan and Boock's view[2] of a primitive respiratory center in the region of the corpora quadrigemina we would say, (1) that we have no evidence of any cells in this region which are sensitive to carbon dioxide in the same sense that the central cells in the medulla oblongata are sensitive to it; and (2) since the corpora quadrigemina themselves are not primitive, it is difficult to see how such a primitive mechanism could be located there.

The activity of the central respiratory mechanism in the medulla is conditioned by (1) the concentration of substances dissolved in the blood, *e.g.,* carbon dioxide; (2) the temperature of the blood flowing through the medulla; (3) the volume of blood flowing through the medulla in unit time, and (4) afferent nerve impulses from various peripheral sensory fields. All these various conditions are summed algebraically in the central respiratory mechanism. This view implies an important extension of our common idea of the summation of stimuli.

The afferent nerve impulses arise, in higher mammals, *e.g.,* the cat, from the lungs and the

[1] Pike, F. H. and Coombs, H. C., *Soc. Ex. Biol. and Med.,* 1917, xv, 55; *Am. Journ. Physiol.,* 1918, xlv, 569; Coombs, H. C., *Am. Journ. Physiol.,* 1918, xlvi, 459; Pike, F. H., Coombs, H. C., and Hastings, A. B., *Soc. Ex. Biol. and Med.,* 1919, xvi, 49; *Am. Journ. Physiol.,* 1921, xlvii, 104; Pike, F. H. and Coombs, H. C., *Am. Journ. Physiol.,* 1922, lix, 472.

[2] Trevan, J. and Boock, E., *Journal of Physiology,* 1922, lv, 331-339.

respiratory epithelium generally, parts of the alimentary epithelium, the pleura, and the muscles of the thoracic wall, the diaphragm, and the abdominal muscles.

The afferent paths are (1) the vagus (tenth cranial nerve) from the lungs and trachea, the fifth cranial from the mucous membrane of the nose, the glossopharyngeal (ninth cranial) from the pharynx and the portions of the soft palate, the phrenic[3] from the diaphragm, the sympathetic[4] from the thoracic wall, and the dorsal roots of the spinal nerves from the thoracic and abdominal muscles.

The central connections of the vagus do not necessarily extend beyond the medulla oblongata. The central connection of the spinal tracts arising from dorsal root fibers are primarily with the mid-brain (region of the corpora quadrigemina) and only secondarily with the medulla oblongata.

We have no evidence of any true respiratory mechanisms of an accessory sort in the spinal cord. The efferent root cells in the spinal cord have no special sensitiveness to carbon dioxide.

The respiratory rate becomes slower after division of both vagi for the reason that afferent impulses over the vagi, which are normally summed with the carbon dioxide in the blood to produce an excitation of the cells of the medulla, are no longer present, and the excitation of the central cells is now dependent in large part upon the carbon dioxide alone. The form of the respiratory movements changes for the same reason that the movements of a limb undergo a change in character when the afferent nerves from the limb are divided, *i.e.*, both types of movements become ataxic.

A further fall in the respiratory rate ensues when, in addition to division of the vagi, there is section of the dorsal roots of the spinal nerves or transection at the lower border of the midbrain because there is a still greater loss of afferent nerve impulses, and excitation of the efferent cells in the medulla oblongata becomes almost wholly dependent upon the carbon dioxide of the blood. The respiratory movements also become correspondingly more ataxic.

Costal movements of respiration fail after section of the dorsal roots alone for the reason that the efferent root cells of the intercostal nerves, which are normally excited by impulses from at least two sources—the descending respiratory motor fibers and the dorsal roots of the intercostal nerves—now receive impulses from the descending fibers only. There is no actual paralysis of the efferent root cells, since costal movements are immediately resumed when contraction of the diaphragm is prevented. This indicates that von Monakow's diaschisis effect is due to loss of some nervous impulses normally entering into the process of excitation of a motor cell.

Our idea of the manner of action of the nervous mechanism for respiration may be briefly stated as follows. Afferent impulses passing into the central mechanism in the medulla oblongata reach the efferent cells through connections which do not pass outside of the medulla itself. The central pathways of afferent impulses over the sympathetic fibers and the phrenics are at present unknown. Afferent impulses coming in over the dorsal roots of the spinal nerves reach the efferent root cells through intra-spinal connections, but the discharge of these cells is withheld until the arrival of impulses over the descending tracts in the spinal cord. Impulses from these two sources are summed in the excitation of the efferent root cells. Other impulses from the dorsal root fibers pass up the spinal cord to the region of the corpora quadrigemina, but whether over the ventral spino-thalamic fibers[5] or over fibers in the spino-cerebellar tracts is uncertain. From the midbrain, these impulses are relayed to the cells of the respiratory center in the medulla oblongata. The excitation of these cells is dependent upon the summation of stimuli arising from (1) the concentration of carbon dioxide in the blood flowing through these cells, and (2) the nervous impulses coming in over the various afferent pathways. The

3 Mathison, G. C., *Review of Neurol. and Psychiatry*, 1912, x, 553.

4 Barry, D. T., *Journ. Physiol.*, 1912, xlv, 473.

5 Ransom, The Anatomy of the Nervous System, Philadelphia, 1920, p. 104.

afferent nerves thus have the double function of (1) contributing to the excitation of the cells in the respiratory center, and (2) of controlling the movements of the muscles arising from this excitation. While it is undoubtedly true that the respiratory center may act automatically under conditions which preclude the effect of afferent impulses[6] it is our opinion that its normal activity is not wholly automatic but partly reflex.

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THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY. II

The application of certain commercial dyes to the reductase test on milk: Minnie F. Dresslar and H. A. Webb. The decolorization of methylene blue by the reductases in milk furnishes a rapid approximate determination of its bacterial age. In order to make the test more convenient for bakers, grocers, restaurant keepers, cooking classes or housewives, who might wish to test milk claimed to be fresh on delivery, eighty-four dyestuffs sold under trade names for household use were tested. By a series of eliminations, the most satisfactory ones were determined, eight in number. They are: "Diamond Dyes" (wool and silk), cardinal, garnet, orange, turkey red; "Rit" dyes, blue, flesh, lavender, red. The decolorization times, which vary for each, but are reasonable, and the effect on various types of milk-whole, skimmer, cream, pasteurized, boiled, malted, condensed, evaporated, were determined. Suggestions for the use of the test by non-technical people are given.

Data on the thickening of condensed milk: Alan Leighton and Courtland S. Mudge.

Use of frozen eggs in mayonnaise: S. K. Robinson. Comparisons between the fresh and frozen eggs were made on batches of mayonnaise. No difference in the product was noticeable, immediately after preparation. Both products were well emulsified and had good body. The following physical tests were then applied: microscopical examination, freezing test, incubation, shaking test and effect of air and light. Not any of these tests put the frozen egg product at a disadvantage. Mayonnaise made from frozen eggs held well in a warm room for thirty days.

Changes in hens' eggs stored in water glass and in lime solutions: F. C. Cook and J. B. Wilson. Strictly fresh and commercial eggs, which were preserved in water glass (1-10, 1-13 and 1-20) and saturated lime solutions. Separate jars of each were stored in the laboratory and in a cellar. At the beginning of the experiment and after various periods samples of the eggs were examined physically, bacteriologically and chemically. Best results were obtained by holding strictly fresh eggs in a 1-10 water glass solution at cellar temperature. Changes of considerable magnitude were found in water, ash and nitrogen contents of both whites and yolks. Bacteria were not found to be a factor in deterioration. Ammonia nitrogen and acidity of fat proved to be the best indices of decomposition.

Manganese, aluminium and iron ratio as related to soil toxicity: R. H. Carr and P. H. Brewer. Much emphasis has been given in the past to the isolation of organic toxins which were thought to be the cause of soil toxicity, while in more recent times the trend of investigation has been turned more specifically to soil acidity as the reason for poor crop yield. Investigations which have been conducted on a large variety of soils using the potassium thiocyanate method for soil acidity and toxicity, described by one of the writers, indicates that the cause of infertility of many soils, supplied with sufficient plant food, is due to the presence of soluble manganese compounds in some cases, to aluminum compounds in other instances and sometimes to a combination of the two. The toxicity of soluble iron is not so apparent, as it is usually associated with a considerable quantity of soluble aluminum in an acid soil. The potassium thiocyanate method has been found helpful in this study, because of the color changes taking place when these elements are present in the soil in easily soluble form. If the soil is more acid than p_H 5.5 a red color of ferric thiocyanate is produced in the presence of soluble ferric iron and if this soil solution containing manganese is made slightly more basic, a green color will develop in the liquor. The depth of the color will be proportional to the amount of manganese in the soil solution. This color begins to form when the soil contains about 0.008 per cent. of soluble manganese. The green color will be found associated with nonproductive acid soils, and since it is shown that manganese does not precipitate as a hydroxide until a p_H of about 7.9 is reached,

6 Stewart, G. N., and Pike, F. H., *Am. Journ. Physiol.*, 1907, xix, 328.