these changes. A chapter each is given to birds, cephalopods, insects and plants, and seven to the mammals. The final chapter on "Retrospect and Prospect" deals with the life of the earth from a philosophical evolutionary point of view.

As viewed in geologic time, organic bodies are constantly changing. Since these bodies are made up of inorganic matter, strong external stimuli are essential in effecting these changes, and the most effective of these stimuli are geologic, since these alone are sufficiently prolonged to change the entire environment. The author, for example, speaks of the Tertiary earth as a new earth, furnishing vegetable food in greater abundance and variety than had ever previously existed. The menace of the reptiles to other animals had largely disappeared, due primarily to the geologic changes which closed the Mesozoic. Under such conditions, it is not surprising that mammals began to thrive greatly and to greatly differentiate.

Dr. Raymond considers the past living forms of the earth, not as resting on a pedestal in a bare room, but in their natural living environment, searching for food, escaping enemies, mating. He describes the beginnings of family life among the vertebrates, their adaptation to life on a terrain similar to that of the present but clad in a more primitive vegetative dress. The author gives background to these animals and makes them live.

The book is enlivened by numerous typical Raymondian expressions. It is probably true that only a man who has thoroughly mastered his subject may treat it at times in a lighter manner, so as to give added enjoyment to both amateur and specialist.

As would be expected in anything written by Dr. Raymond, the subjects are discussed with an open mind as to theories and clearly and concisely in expression. The book is replete with new ways of looking at old facts. It must be read by all teachers of the subject who wish to enliven their lectures and class work, and it should be read by all who are interested in the past life of the earth.

HERVEY W. SHIMER

SOCIETIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE spring meeting of the academy was held on May 5 and 6 at Murfreesboro. At this meeting a plan for placing the academy library in the custody of the Joint Vanderbilt-Peabody-Scarritt Library was approved and a resolution favoring the purchase and maintenance by the U. S. Forest Service of a Rhododendron Garden area on Roan Mountain was adopted. Dr. Dorr R. Bartoo, of the Tennessee Polytechnic Institute, was awarded the American Association for the Advancement of Science research grant of $75.00 for 1939. Dr. Aaron W. Dicus was appointed to represent the academy at the meeting of the American Association for the Advancement of Science, in December, 1939.

For the fall meeting on December 1 and 2 at George Peabody College the Industrial Arts Building, with three large lecture rooms on the second floor, provided ideal facilities for the general sessions which were held on Friday and Saturday mornings and the sessions of botany, geology and physics on Friday afternoon.

There were 46 papers on the program—20 for the general sessions, 12 for the geology, 7 for the botany and 7 for the physics section. Ten schools were represented—4 in East Tennessee, 4 in Middle Tennessee and 2 in West Tennessee. Members of the Tennessee Valley Authority and of the State Department of Conservation contributed eight papers. Geologists founded the academy and became its chief promoters. In recent years the botanists have led. The geologists now seem to be gaining. The hearty support of the schools, the T.V.A. and State Conservation Department is noteworthy.

The paper by Professor George R. Gage, of Vanderbilt University, on "Two New Tree Diseases of Epidemic Severity in Tennessee" was of both general and local interest. The persimmon wilt, discovered in Tennessee in 1937, is prevalent in at least six counties of Middle Tennessee. No measures of control have been instituted. A virus elm disease which has killed thousands of elms in the middle and lower Ohio Valley is believed to be the cause of the loss of five American elms on the Vanderbilt Campus in the last three years, and the disease may be epidemic in Tennessee.

In an informal report, Dr. Baker, director of the Reelfoot Lake Biological Station, outlined the character of the researches made last summer by the twelve persons who had been accepted by him for scholarships.

Dr. William M. Mebane, vice-president, presided at the dinner meeting on Friday evening at the Hermitage Hotel. After an address of welcome by Dr. D. S. Campbell, of George Peabody College, President Dicus gave the academy address, taking as the subject "Reveries of a Scientist." Following this a motion picture illustrating the effects of mineral element deficiencies in plant growth was shown.

At the business meeting on Saturday morning, the secretary-treasurer, speaking of the activities of the academy, said two annual meetings had been held, 700 copies of the Journal had been published quarterly,

between five and six hundred copies had been sent out to more than 400 members, 26 state academies of science affiliated with the American Association for the Advancement of Science, 118 other addresses of scientific bodies, libraries, etc., including 28 in thirteen foreign countries. About 20 per cent. of the reserve fund would have to be used in order to balance income and outgo. Respecting the Reelfoot Lake Biological Station he said that the legislature of 1939 had made an appropriation to the academy of $4,000 for the biennium beginning on July 1, 1939, and the State Department of Conservation had added $500 in consideration of researches made there pertaining to the solution of fish and game problems.

Dr. Clinton L. Baker was reelected director of the Reelfoot Lake Biological Station, and Dr. George R. Mayfield, a member of the advisory committee, each for a term of three years. Dr. John T. McGill, in consideration of his services to the academy during the last fourteen years, was elected honorary president for life, with membership on the executive committee without official responsibility.

OFFICERS FOR THE YEAR 1940

President, C. L. Baker, Southwestern, Memphis; *Vice-President,* F. Lynwood Wren, George Peabody College, Nashville; *Secretary-Treasurer,* Kendall E. Born, Division of Geology, Nashville.

Botany Section, *Chairman,* C. R. Freeman, Teachers College, Memphis; *Secretary,* Stanley A. Cain, University of Tennessee, Knoxville.

Geology Section, *Chairman,* Walter F. Pond, Division of Geology, Nashville; *Secretary,* Kendall E. Born, Division of Geology, Nashville.

Physics Section, *Co-Chairmen,* K. L. Hertel, University of Tennessee, Knoxville; Newton Underwood, Vanderbilt University, Nashville.

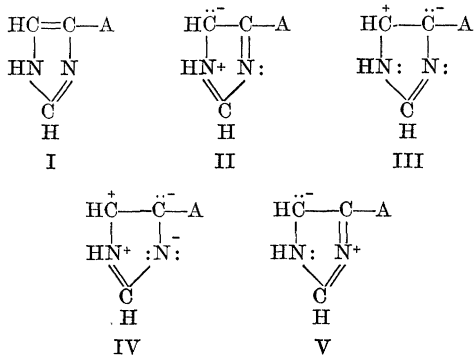
J. T. McGILL

SPECIAL ARTICLES

RESONANCE AND THE CHEMISTRY OF HISTIDINE

CERTAIN of the chemical characteristics of histidine, β-imidazole-α-amino propionic acid, are readily explained by a consideration of the fifteen principal forms of the compound in resonance. These forms can be classified into four groups, each containing structures with similar energies, and the forms of each group may be weighted somewhat arbitrarily (any reasonable assignment of weights leads to the same qualitative results).

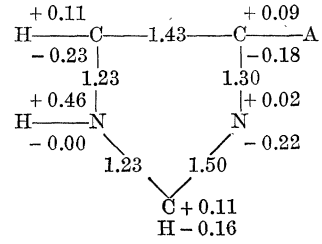
Group 1: The classical structure of histidine (I), where A is the alanine residue. Weighting 30. *Group 2:* Four forms in which there is a single separation of charge and octets about all atoms, *e.g.,* II. Weighting 10. *Group 3:* Five forms containing a single separation of charge, but a sextet about one atom, *e.g.,* III. Weighting 5. *Group 4:* Four structures with a double separation of charge and a sextet about one atom, *e.g.,* IV. In addition, V is placed in this group, due to the two adjacent double bonds. Weighting 2.



I II III IV V

The resonance forms of the other tautomer of histidine are the same, with the functions of the ring nitrogens reversed.

The degree of bondedness between each pair of atoms of the ring and the charges on each atom are summarized in VI as time averages, where one unit of charge (charge on an electron) or bondedness (single bond) is equivalent to a total weighting of 105 (30 + 40 + 25 + 10).



VI

Recalling that a double bond to a nitrogen or a positive charge decreases its basicity and increases its acidity, while a negative charge has the reverse effect, the nature of the three nitrogen atoms of histidine may now be considered. (1) The amino nitrogen of the chain does not participate in the resonance of the ring and therefore is similar both in reactivity and basicity to α-amino groups of other amino acids (*i.e.,* expected pK_b about 5). (2) The secondary amine nitrogen of the ring has a charge of almost $+\frac{1}{2}$ and is not quite $\frac{1}{2}$ double bonded on either side. The similar resonance in pyrrole gives its nitrogen about the same positive charge and degree of bondedness. Thus this nitrogen in histidine, like that of pyrrole, is very weakly basic