Research Notes.

Induced Radioactivity.

IN the *Comptes Rendus*, **198,** p. 254 and p. 559, 1934, *Mme.* Iréne Curie and *M.* F. Joliot describe some extremely interesting experiments on the artificial production of new radioactive elements. They had previously found (*Comptes Rendus*, **196,** 1885, 1933) that some light elements such as beryllium, boron and aluminium emit positive electrons when bombarded by α-rays from polonium. According to their interpretation the positrons from beryllium must be due to the internal conversion of γ-rays into matter, whereas in the case of B and Al the positrons must be due to a process of transmutation accompanying the emission of neutrons. In the course of further study they discovered the interesting fact that the emission of positrons continued for an appreciable time after irradiation with α-rays had been stopped and that the intensity of this positron emission decreased exponentially, showing *different* periods, as in the case of the radioactive elements. The periods thus found were 3 min. 15 sec., 14 min., and 2 min. 30 sec., respectively for Al, B and Mg. The elements H, Li, C, Be, N, O, F, Na, Ca, Ni, Ag showed no such activity. In some of these cases there might be no activity at all, while in others the period is too short.

The explanation given by Curie and Joliot is as follows: in the case of Al the reaction represented by the equation

$$Al_{13}^{27} + He_2^4 \rightarrow P_{15}^{30} + n_0^1$$

takes place, *i.e.*, the α-particle is captured by the Al nucleus resulting in the formation of P^{30} and emission of a neutron. The P^{30} nucleus is, however, unstable and disintegrates according to the equation

$$P_{15}^{30} \rightarrow Si_{14}^{30} + E^+.$$

The corresponding equations in the case of B and Mg are

$$B_5^{10} + He_2^4 \rightarrow N_7^{13} + n_0^1;\ N_7^{13} \rightarrow C_6^{13} + E^+$$
$$Mg_{12}^{24} + He_2^4 \rightarrow Si_{14}^{27} + n_0^1;\ Si_{14}^{27} \rightarrow Al_{13}^{27} + E^+.$$

In support of their explanation, Curie and Joliot have chemically proved the existence of Nitrogen and Phosphorus in the activated samples of *Boron* and *Aluminium* and they have also shown that the activity is due to the Nitrogen and Phosphorus thus proved to exist. This is the first time that a nuclear reaction expected according to considerations of energy has been chemically verified, since in previous cases of artificial disintegration, the process was instantaneous and gave rise to stable nuclei. The elements N_7^{13}, P_{15}^{30} and Si_{14}^{27} thus artificially produced and shown to be radioactive have been named respectively radio-nitrogen, radio-phosphorus and radio-silicon by the discoverers.

Very recently L. Meitner (*Naturwiss*, **22,** 172, 1934) has studied the transformation in Al by means of the Wilson camera and has shown that Al disintegrates in two ways under bombardment with polonium α-rays, *viz.*, according to the schemes

$$Al_{13}^{27} + He_2^4 \rightarrow Si_{14}^{30} + H_1^1 \quad \text{and}$$
$$Al_{13}^{27} + He_2^4 \rightarrow Si_{14}^{30} + n_0^1 + E^+$$

which is the one considered above.

Meitner has also shown that the frequency of the first of the above kinds of transformation is about four times that of the second.

Endocrine Control of Ovarian Functions.

C. W. BELLERBY (*Biochem. Jour.*, **27,** No. 6) has substituted very profitably *Rana temporaria* and *Xenopus lævis* in place of mammals for determining the action of the pituitary extracts on the activity of the Ovary. It is noticed that in the two amphibians, the pituitary is easily accessible. In the first place alkaline extracts of the anterior lobe pituitary have the same effects as acid extracts. This is a fact of some importance as it has till now been assumed that there are two distinct substances in the extracts which perform two different functions, *i.e.*, follicular growth and luteinisation. It is on the other hand more likely that we are dealing with a single substance which produces results apparently antagonistic. Bellerby is inclined towards the latter hypothesis.

Urinary Excretion of Vitamin C.

THE paper by L. J. Harris, S. N. Ray and A. Ward (*Biochem. Jour.*, **27,** No. 6) has probably great applications for dietetics. By the titration method with 2: 6 dichlorophenolindophenol they have demonstrated the presence of vitamin C in human urine and have found that in normal individuals, the daily loss of vitamin C in urine is about 30–33 mg. which is really a little greater than the reputed quantity required by man. It is interesting to note that in the case of

an individual who has imbibed a single large dose of vitamin C (about 600 c.c. of orange juice) the concentration of vitamin C in the urine rises very rapidly reaching in about three hours the maximum, which is nearly 10 times the normal. A rapid fall ensues and even if the subject is kept free from vitamin C diet for a week or more, the daily quantity of about 33 mg. is maintained.

Germination of Seeds.

THE influence of electrolytes and non-electrolytes on germination and the subsequent development of seeds is a fascinating subject which is just attracting the attention of plant physiologists. I. A. Volkov (*Bull. Appl. Bot. Gen. Plant Breeding*, III Series, No. 3, p. 131, 1933) has investigated the influence of sugar solutions and glycerine in the germination of different seeds of agricultural importance. In *Avena byzantina* the several phases were accelerated by more than a week, increasing simultaneously the dry matter content. The strongest effect was noticed in solutions of 0·4 N sucrose and 0·5 N glycerine. The effect is less marked with wheat, while the stimulating action on the flax seeds was practically nothing. The author concludes that one of the factors which accelerate reproduction in the cereals is the accumulation of sugars. The seeds of oleiferous plants germinate equally well in water and in glycerine.

Drought Resistance in Fruit Trees.

WATER supply is one of the chief factors controlling plant growth. In the absence of moisture in the soil, the development of plants is enormously modified leading finally to their death. But it often happens that the soil holds moisture in insufficient quantities, leading to a condition, known as soil drought. The capacity of plants to grow in such cases is varied. An interesting contribution on the ability of fruit trees to withstand such drought has been made by A. Richter (*Bull. Appl. Bot. Gen. Plant Breeding*, III Ser., No. 3, p. 189, 1933). The author has adopted the wilting method successfully wherein the plants are kept at the hygroscopic moisture content of the soil for 8–10 days, and subsequently allowed to recover. Different plants lose different amounts of moisture under such treatments. The author tried the peach, the plum, the prune, the apricot, the cherry, the fig and the almond plants.

Striking morphological adaptations are noticed in the foliage of those plants. In one set, consisting of the peach, plum, apricot and some varieties of prunes, the leaves are found to withstand considerable moisture deficiency, without exhibiting any diminution in the transpiration surface, in such a case it is but natural that the rate of transpiration is considerably lessened. In the other set, comprising of the almond, the fig, the sweet cherry and one variety of prune, the foliage cannot support such a deficit and consequently the leaves drop off decreasing the transpiration surface enormously—a feature which is so common in the desert plants. The manifestation of either of this property is little influenced by the developmental phase of the plant either vegetative or resting.

The author has arranged as follows the stock of the fruit trees examined in the order of their resistance to soil drought: (*a*) the most resistant—the fig, the almond and the peach; (*b*) less resistant—a variety of prune, *Prunus Mahaleb* and the sweet cherry; (*c*) poorly resistant—*Prunus divaricata, P. spinosa* and the plum; and (*d*) highly susceptible to drought—the apricot.

The significance of such studies cannot be ignored for a tropical country like India, where the weather conditions are so varied.

Classification, Bionomics and Evolution of Homalopterid Fishes.

DR. SUNDER LAL HORA has made a signal contribution to our knowledge of the fishes of India by bringing out his extensive monograph on the Homalopterid fishes (*Memoirs of the Indian Museum*, **XII**, No. 2. pp. 263–330). Much of his recent work has centred round the extensive examination of torrential and mountain-stream-dwelling fauna and Homalopterid fishes constitute an important portion of this fauna. The first part of this work deals with the classification of the family where all the species have been described. The family is divided into two sub-families—Homalopterinæ and Gastromyzoninæ. There are six genera in the first sub-family and eleven in the second. The diagnostic characters of all the genera are tabled and they will doubtless prove of valuable assistance to every worker on Homalopterids. Several new genera have been described by the author,—Protomyzon,

Annamia, Sewellia, Vanmanenia and Beaufortia.

The second part of the work deals with the bionomics and evolution of the family. On account of the peculiar habits of these fishes which live in fast-flowing mountain torrents, clinging to rocks, several interesting modifications have arisen; the body has become flattened dorsoventrally, the scales on the under-surface have become reduced or are completely absent, and the paired fins have become modified in a remarkable manner to aid in the adhesion of the animals to the substratum. It is noticed that these modifications have arisen independently in the two different subfamilies, consequent on the assumption of the habit of living in the fast-flowing torrential streams. The respiratory and feeding mechanisms are remarkable, having been modified to suit the peculiar environment.

The Hyoid and Larynx of the Anura.

THE study of the amphibian larynx has been engaging the attention of workers from a long time and very recently W. Blume extended our knowledge on the microscopic anatomy of this structure in anura by publishing an exhaustive contribution in *Morph. Jahrb.* (Dec. 1930). No doubt this subject is a very fascinating study. Since the variations noticed in this extremely plastic structure are so many, we may not be correct in taking into account the morphology of this structure for purposes of classification of this group. The latest contribution to the gross anatomy of the larynx and hyoid is by Miss E. Trewavas (*Phil. Trans. Roy. Soc., Lond.*, B. 222, 1933) whose paper fills a large gap in our knowledge of the comparative anatomy of the larynx. She has studied many genera belonging to the different orders of the group anura and has given a comprehensive account of the larynx and hyoid apparatus in them including the South American form *Leptodactylus ocellatus*, which she treats as a generalised form. The description given for this and also for that of *L. prognathus* closely corresponds to that given for *Rana* by previous workers. In the other species of *Leptodactylus*, *viz.*, *L. caliginosus*, the cricoid annulus is incomplete ventrally with the low cardiac process separated by a gap. Moreover, the œsophageal process is exceedingly short in the female.

Similar variations both in the disposition of the muscles of the hyoid and the structure of the larynx have been described in other forms. Describing the group Pelobatidæ the author reports that the hyoid musculature resembles very closely the generalised Leptodactylid or Ranid type and supports the thesis that Pelobatidæ marks a distinct advance over the Liopelmidæ and Discoglossidae. Further, the incompleteness of the cricoid annulus among the Pelobatid examples studied by Miss E. Trewavas recalls the condition in some species of Leptodactylidæ. In *Rhacophorus dennysi* also, the same incompleteness prevails and it is surmised that this is a case of convergence of features. In one of the examples of the group Leptodactylidæ, *Crinia*, an intimate union of the cricoid annulus with the cartilaginous epiphysis of the posterior cornu of the hyoid is described. This feature is also noticed very pronouncedly in the examples of the group Brachycephalidæ and to a much less extent among the species of Bufo. An examination of both *B. himalayanus* and the more common *B. melanostictus*, will reveal that, at the outset, the union is not so close in these Bufonid examples as in the Brachycephalidæ but to a lesser extent. It is easier to remove the larynx from the fork of the posterior cornu of the hyoid in *B. melanostictus* than in *B. himalayanus*. On page 455, the author while describing the larynx of Bufonid examples gives under the title of *Bufo himalayanus* four sectional views of the larynx of the metamorphosing toadlet. In a footnote on the same page she reports about the sections thus, 'They were labelled *B. melanostictus*, but since the specimen came from India, they are more probably *B. himalayanus*.' This is not so, for the more commonly distributed form throughout India is *B. melanostictus* and Boulenger points out that *B. himalayanus* is restricted to Himalayas (Nepal and Sikkim).

The vocal organ of the examined species of *Rana*, *Megalixalus* and *Rhacophorus* is built on a common plan. They all possess the apical cartilage though not in many cases separately, from the arytenoids. The shape of the cricoid varies among the many species of *Rana* but invariably the females are characterised by the possession of the œsophageal process. No doubt there are certain exceptions as for example the males of *R. greyi* and some specimens of *R. breviceps* that are endowed with this process.

The separation of Cacosternum from the Brevicipitid group and its treatment under

a separate category is thoughtfully done. We learn from a study of the cranial osteology that this animal could no longer be brigaded under the Engystomatidæ and should be more correctly treated under Ranidæ. Most of the characters described for the group Brevicipitidæ have already been given in a paper published in the *Half-Yearly Journal of the Mysore University* (L. S. Ramaswami, *Journ. Mys. Uni.*, **6**, No. 1, 1932). The peculiar possession of a bony or cartilaginous median portion of the hyoid, the absence of the apical cartilage and the œsophageal process, the peculiar expansions of the terminals of the broncheal process have already been noted. At any rate, the absence of an omohyoid, the presence of only two petrohyoidei muscles are new. Except Hemisus and Breviceps, there seems to be a fundamental unity of characters underlying all the members of the Brevicipitidæ.

There still remains a large number of genera to be examined and the histological details would be extremely interesting and perhaps might reveal many new features.

L. S. R.

The United Provinces Grid.

THE further installations of low-head, slow-speed, vertical propeller type turbines at Bahadrabad and Bhola Falls in the Ganges Canal and the speculative proposition of harnessing the Sarda Canal for electrical energy purposes, to complete a grid, spreading all over a purely agricultural province with hardly any concentrated industrial loads has fulfilled the expectations of the Government in the direction of rural electrification. The existing Ganges Canal hydro-electric scheme started in 1928 has succeeded by 1931 in exploiting the water power resources of a number of low head falls to the extent of 5700 KW. which was continually going to waste in the irrigation canals of the province. The canal is 163 miles long between its head-works at Hardwar and Sumera Falls—the last fall in the Canal. The country has an average gradient of one foot per mile and this slope has been absorbed in a series of thirteen falls of heights ranging from twenty to nine feet. The ultimate total capacity when the scheme is completed will be about 30,000 KW. The four falls out of these have been harnessed as follows:—

No.	Distance from Head-works (Miles)	Generating Station	Head used (feet)	No. of turbine sets	KW.	Quantity of water required (Cusecs)
1	7	Bahadrabad Falls	19	4	2400	4000
2	84	Bhola Falls	15	4	1500	1700
3	148	Palra Falls	8	3	600	1200
4	163	Sumera Falls	14	2	1200	1000

The transmission grid includes these four generating stations, about 1000 miles of h.t. lines and 90 transformer stations and it has been so interlinked that uninterrupted and efficient service can be maintained even when there is a shut down of any one station. The energy is consumed by (1) the districts of Bijnor, Moradabad, Sahranpur, Muzaffarnagar, Meerut, Bulandarshahr and Aligarh; (2) Pumping stations at Ramganga and Kalinadi for pumping 300 cusecs of water to irrigate 80,000 acres of land; (3) Agricultural and rural industrial loads. The main transmission voltage is 37 KV. and also includes a portion of double circuit. The branch lines operate at 11 KV. and they have cost Rs. 8,800 and Rs. 4,000 per mile respectively and still cheaper rural lines are being erected and they compare favourably with lines of similar capacity hitherto constructed elsewhere. In the design of the grid, allowances have been made for future growth of load. The distribution has been left to the private companies. In spite of this elaborate network, this scheme is serving a total urban population of 952,000 at a sufficiently cheap rate and even cheaper to the rural industries. The novel engineering feature of the enterprise is the installation of generators on the existing foundations instead of on a detached one which has considerably reduced the initial expenditure. The total capital cost amounted to about Rs. 150 lakhs and the gross revenue has increased from Rs. 7½ lakhs in 1932 to Rs. 10 lakhs in 1933.

Another distinctive feature of this scheme is that it will incur additional capital expenditure only when a corresponding guaranteed demand arises. If need be, a similar scheme may be successful in later years in harnessing the Jumna Canal.

T. D. CHATTERJI.