view of the path of oscillation of the vertebral column of bird.

Thus we may say that those animals that oscillate their cephalic end during the embryonic stage when the migratory connective tissue cells are entering through the intervertebral zones of the perichordal tube have ophisthocœlous, and those that move their posterior portion of their body, keeping the anterior end in a so-called stationary condition generally have procœlous and when there is an intervertebral ligament intervening between the ball and socket of a procœlous vertebra we get a depression on the top of the ball of the centrum in order to accommodate the intervertebral ligament forming a heterocœlous vertebra, while those that do not oscillate their body and keep them in a so-called stationary condition generally have amphicœlous vertebra.

So we may conclude in the words of Prof. MacBride, "Habit changes first and structure a long time afterwards. Habit is the real driving force in evolution."

Irrigation Research in the Bombay Presidency.

1. THE Special Irrigation Division was opened in June 1916 and in 1927 the Irrigation Development and Research Circle was created to apply the results of research on a large scale.

In 1930 the Development and Research Division was opened in Sind. Owing to shortage of funds the Irrigation Development and Research Circle was abolished in 1933 on the recommendations of the Reorganisation Committee. Land drainage—which amounts to application of research—has been handed over to the local engineers, and research work to a new Irrigation Research Division. Continuity has been maintained due to the application of research being controlled by the same officer who previously directed research.

2. When waterlogging and salt efflorescence investigations were started in 1916, soil physics was found to be an exceedingly important factor. A staff of agricultural graduates was gradually built up under whom sub-soil classification from surface indications was worked out. This was a long and many-sided investigation of great interest—covering geology, soil physics, ecology, and the flow of sub-soil water. These investigations led to an entirely successful theory regarding drainage requirements being evolved. Since then several drainage schemes have been constructed by the Special Irrigation Division, with highly satisfactory results.

3. Simultaneously the disposal of the sewage effluent from Poona was undertaken—using it to irrigate a large cane area to the east of Poona. To investigate this question 60 acres of land were acquired near Hadapsar.

4. The corollary to the solution of the drainage problem was that of reclaiming damaged land. In many parts of the Canal tracts reduction of waterlogging combined with good cultivation was sufficient to restore the condition of the soil, but research had to be done in connection with soils, which had been damaged by salt efflorescence as a result of which they had become sodiumised.

5. The first drainage and reclamation works were carried out at the Baramati Experimental Salt Area (on the Nira Left Bank Canal) where some 160 acres of the worst land in any of the Canal tracts were acquired and drained. Of the 134 acres of land in the Baramati Experimental Salt Area, 100 acres are now suitable for growing good crops of sugarcane.

6. Drainage and reclamation methods soon gave promising results; so problems in connection with irrigation—by which is meant "increasing the fertility in soils by an artificial supply of water"—were then investigated. The policy regarding irrigation was *to modify agricultural methods to fit irrigation limitations, and to mould irrigation practice to meet agricultural requirements.*

7. This necessitated improved control of water by measuring and regulating devices, which led to the introduction of Standing Wave Flumes and Gibb modules. To perfect the design of these and other measuring devices, model experiments were started. These proved highly successful, and the work done at the Hydrodynamical Research Station soon became widely known, so that requests to test designs by models were frequent. This work became so important—largely because of the remarkable facilities at Poona—that many problems concerning Sind irrigation—especially in connection with Sukkur Barrage and Canal designs—were dealt with.

These included :—

*(1) Modification of design of Barrage floor to keep the standing wave close to the Barrage under all conditions of flow,
*(2) Best design for Barrage piers,
†(3) Best design of divide walls.
‡(4) Silt exclusion from Barrage Canals,
§(5) Dissipating energy below falls,
(6) Silt exclusion from Mithrao Canal,
(7) Coefficients of discharge of Barrage Gates on running and falling gauges,
(8) Relative merits of various types of falls for dissipating energy.

Hydrodynamical research work is steadily widening in extent and importance—largely due to the new Research Station at Khadakvasla near Lake Fife (11 miles from Poona) where very exceptional facilities for discharges of clear water up to 500 cusecs under constant head are available.

8. One of the direct results of drainage research was the necessity for restricting sugarcane irrigation in the absence of drainage. The whole of

*(1) & (2) *Technical Paper* No. 29.
†(3) *Technical Paper* No. 52.
‡(4) *Technical Paper* Nos. 45 and 46.
§(5) *Technical Paper* No. 44.

the Deccan canal areas have therefore been surveyed as regards substrata and subsoil water levels and their connection with irrigation and percolation from channels.

Based on this, soils have been classified as regards permissible intensity of irrigation—with and without land drainage—and limits of cane irrigation have been fixed by catchments and sub-catchments.

Similarly fruit gardens have been restricted to areas where the most suitable soil-cum-drainage conditions will continue to prevail.

9. The block system, originated in 1906 by Sir M. Visvesvaraya, has been improved by unitisation and standardisation and is now enforced on all the Major Canals in the Deccan.

10. In Sind the Development and Research Division was opened in 1930. Under it complete subsoil surveys of the Lloyd Barrage areas have been made and maintained up to date; much work has been done on models of various masonry works, resulting in standardisation of design: investigations into flumes, falls and flow in channels are in hand, and an important silt survey of the Indus, the Nara and the Jamrao Canal is also being carried out.

11. The formation of a Central Committee of Research, subsidiary to the Central Board of Irrigation, which was formed a few years ago, was a step of immense importance to the future of all-India Irrigation Research.

12. 25 Bombay Public Works Department Technical Papers dealing with the researches carried out in the Deccan and 10 dealing with those in Sind have been published and are obtainable from the Superintendent, Government Printing and Stationery, Bombay; through the High Commissioner for India, India House, Aldwych, London, W. C. 2; or through any recognised Book-seller.

Research Notes.

On a Theorem of Milloux.

DINGHAS (*Math. Zeit.*, 39, pp. 590–596) has succeeded in generalising a theorem due to Milloux about integral functions of infinite order, by means of which he proves some results about a class of integral functions of infinite order which are analogous to some theorems in the theory of integral functions of finite orders—*e.g.*, Phragmen-Lindlöf theorem and Denjoy-Ahlfors theorem—on the maximum number of asymptotic values of an integral function of finite order. The theorem that he proves (analogous to Phragmen-Lindlöf theorem) at the outset is that if an integral function $f(z)$ satisfies the conditions set forth below in the infinite strip defined by $z = x + iy$,

$$x \geqslant 0, \quad |y| \leqslant \frac{\pi}{2k},$$

$$\overline{\underset{n\to\infty}{\text{Lim}}}\; e^{-\rho x} \operatorname{Log} M_0(x) = 0,$$

[$\rho > 0$, and finite]

$$\overline{\underset{n\to\infty}{\text{Lim}}}\; e^{-\rho x} \operatorname{Log} M(x) = \sigma \neq 0$$

where $M_0(x) = \text{Max} \left| f\left(t \pm \frac{\pi i}{2k}\right) \right|$ for $0 < t \leqslant x$,

and $M(x) = \text{Max} \, |f(x+iy)|$ for $|y| \leqslant \frac{\pi}{2k}$,

then $k \leqslant \rho$.

The proof of this theorem depends on the following lemma. If $g(z)$ is an integral function, satisfying the conditions

$$\left| g\left(x \pm i\frac{\pi}{2k}\right) \right| \leqslant M_0. \qquad |g(x+iy)| \leqslant M,$$

$$|g(iy)| \leqslant M_0 \quad \text{in } 0 \leqslant x \leqslant a, \quad |y| \leqslant \frac{\pi}{2k}$$

(It is supposed that $M_0 < M$)

then $\log |g(z)| \leqslant \log M_0 + \frac{4}{\pi} \log \frac{M}{M_0} e^{k(x-a)}$.

After the proof of this theorem he introduces the notions of order, type, etc., for a class of integral functions of infinite order. [The order ρ is defined as $\text{Lim} \frac{\log \log M(x)}{x}$, where $M(x)$ is the maximum of $|f(z)|$ for $|y| \leqslant \frac{\pi}{2T}$. With these definitions he proves the following interesting result.—There does not exist any integral function of order ρ (in the new sense) in a strip of breadth less than $\frac{\pi}{\rho}$ and which is of minimal type if it is of the same order in any sub-region of the strip and which is of either the maximal or the normal type. After proving another lemma he deduces another interesting result in connection with this class of integral functions which is analogous to the Denjoy conjecture about the asymptotic values of an integral function of finite order which was proved by Ahlfors in 1930.

K. V. I.

On the Prime-Numbers of Some Arithmetical Progressions.

ERDOS (*Math. Zeit.*, 39, pp. 473–491) develops a method for the proof of the