RECENT INVESTIGATIONS ON THE GROWTH OF BONE

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ANY condition in which bone grows or disappears seems bound to involve some of the mechanisms of normal bone growth. Therefore it was felt that, in the long run, the best way to approach some of the problems of surgical bone pathology would be to deal first with normal development, and to submit the whole question to a new inquiry in the light of recent embryological advances.

The first results of this study are now being published[1] and will be briefly summarized here.

(1) In rabbits, the distal growth cartilage of the radius and the growth cartilage of the rib were cut off by two transverse and parallel sections. Their peripheral region was then entirely taken away by four sections at right angles. The disk-shaped growth zone was thus reduced to a small cube consisting exclusively of cartilaginous tissue without any remnant of the ossification groove (Ranvier's "encoche d'ossification"). This piece was grafted into the brain or under the kidney capsule or into the medullary cavity of the tibia in other rabbits. When recovered, it was found to have produced a large quantity of endochondral trabeculæ which were being resorbed and replaced by hæmopoietic marrow. All around the cartilage, cells which seemed to be ordinary fibroblasts had gathered. Some of these cells had taken part in the formation of a thin bony lamella surrounding and flanking the growing cartilage. The formation of this bony ring is a typical example of an induction phenomenon.

Now this observation led to the reconsideration of the structure of the growing long bones, and it was found—however surprising it may seem that such an obvious detail could have been overlooked thus far—that the ossification groove contains a perichondrial ring identical with that of the grafting experiments. The formation of this ring was traced back as follows: in its earliest stage the diaphysis is a continuous bony tube, but after a while its extremity is cut off from the rest of the bone by osteoclasts and becomes the perichondrial ring of the ossification groove; this change of structure is brought about by the endochondrial tabeculæ beginning to take part in the constitution of the diaphyseal extremities.

From these facts it was inferred that the formation of the normal perichondrial ring and of the earliest form of the diaphysis is the result of inductive activity depending directly or indirectly on the growing cartilage.

(2) Yet another instance of an induction phenomenon in bone growth is provided by the following experiments. A rod of hyaline cartilage was taken from the rib of a rabbit and put into the upper extremity of the tibia of another young rabbit in such a manner that it pierced the centre of its proximal growth cartilage. The latter, in spite of its having been wounded, went on proliferating and a close contact was established between the grafted cartilage and the growth cartilage. After a few weeks the grafted cartilage was the seat of a typical endochondrial ossification. Since the serial sections proved that no cells of the host cartilage had invaded the graft, the phenomenon was to be considered as one of assimilatory induction.

(3) The two previous groups of experiments are clear-cut evidence of the part played by induction at a much later stage than one would ever have thought. They point strongly toward the existence in the growing cartilage of an organizer. The question has been pushed another step forward by the following crucial experiments.

An alcoholic extract has been prepared from the cartilaginous epiphyses of the long bones of newly born rabbits and injected into the thigh muscles of other rabbits. Forty-one days afterwards, a large osteoma was found in the thigh. Its histological examination revealed the presence of all the structures which may be analysed in a growing long bone: growth cartilage with its characteristic row arrangement and partially surrounded by a perichondrial ring of the ossification groove, circular or triangular diaphysis enveloped by a periosteum and containing a functional hæmopoietic marrow.

Thus not only the endochondrial ossification but even the organization of the diaphysis seem to be under the influence of a substance or a group of substances which I suggest calling *osteogenin*.

According to the view put forward at the beginning of this article, evidence should now be sought of the intervention of such a factor in various pathological and surgical conditions (periosteal and medullary osteogenesis, formation of a fracture callus, evolution of a bone graft, etc.). Further research will then have to show whether the possibility of promoting osteogenesis at will is really within easy reach.

[1] *Mém. Acad. Roy. Méd. Belg.*, **2**, Fasc. 2 (1943). *Acta biol. belg.*, **3**, 93 (1943). *ibid.*, **3**, 124 (1943). *ibid.*, **3**, 125 (1943). *ibid.*, 25 mars 1944 (in the press). *Arch. Biol.*, **56**, 185 (1945). *Anat. Rec.*, 1945 (in the press). *Arch. Biol.* Fasc. 3, 1945 (in the press).

SCIENTIFIC AFFAIRS IN EUROPE

FROM time to time news is being received of scientific men and institutions on the Continent of Europe, who have been cut off from Great Britain for some five years. A note referring to some Belgian biologists and Belgian biological publications, based on material provided by Dr. Julian Huxley, appeared in *Nature* of August 11, p. 166. Dr. John W. Wells contributed an article on French and German geographical and geological institutes to *Nature* of August 25, p. 243. Dr. F. W. Sansome has referred to correspondence with some Danish men of science (*Nature*, September 1, p. 263). Now Dr. Huxley has put at our disposal two letters received by him from Dr. N. Tinbergen, of Leyden, and Dr. A. Buzzati-Traverso, of Verbania, Pallanza, Italy, the substance of which is printed below.

Throughout all these communications, the intense desire to re-open relations with scientific men in Great Britain is apparent, and it is to be hoped that British men of science will, as soon as conditions permit, get into touch with correspondents in the liberated countries and exchange reprints with them, in the interests of international relations.

From Dr. Tinbergen:

The situation in the Netherlands is still more or less chaotic. We have great admiration for the swift and efficient help by the 'food flying squads' that have brought immediate relief to our people at an instant when thousands were dying of starvation. We owe an enormous debt of gratitude to the instigators and organizers of that huge enterprise. Real

hunger is over now, but the after-effect, bodily and moral and spiritual, of the German terror and hunger combined is still evident. . . .

Scientific work, which was little affected in the first year of occupation, has practically come to a standstill in the last year. In 1942 we had a great clash with the Germans, who wanted to nazify the University of Leyden; we did not 'surrender' and took our leave; as a reprisal we were put into an internment camp as hostages, and spent two years there. They did not shoot us, however, and all but one of us have safely returned. That one was Prof. Telders, who died in a German concentration camp. In Utrecht, Jordan has died.

I want to renew and intensify the contact and co-operation with British students of behaviour, and I am sure most of my Dutch colleagues in the field of animal psychology are of the same opinion: we all have a great longing for international interchange of ideas. I do not intend to cut off all relations with German scientific men. But first I must not see them for a long time, so as to overcome the psychological aversion resulting from the incredible German terror we underwent; and secondly I want only to renew contact, eventually, with those investigators that I personally know as honest and reliable men, such as Rensch, von Frisch, Stresemann, Lorenz and (I hope) Laven.

As soon as it is permitted, I will send you the publications that have appeared in my department between 1939 and 1942, the year of the clash with the Germans, when I stopped all publishing. The other universities did not have such a formal clash, though all of them were languishing. Much of my own recent work has been centred on "das angeborene auslosende Schema" ('releasing mechanism'); field work on *Satyrus semele*, published in *Z. f. Tierpsychologie*; laboratory work with the three-spined stickleback, an excellent object (most of this work still unpublished); laboratory work with a number of Cichlid fishes (unpublished); and field work with the herring gull (only short papers on fragments of the work). Continuation of this last piece of work will be impossible for some years, to my great regret, as the dunes are 'peppered' with land mines.

Bierens de Haan, after nearly dying of starvation, is all right again; he has written a voluminous book on instincts, and now is writing one on the psychology of the dog. Portielje is all right, and active as ever. He wrote an interesting study of the orang-utan. Verwey had to leave his laboratory in Den Helder, which in the course of the War was absolutely robbed by the Germans; he was fifteen months among us as a hostage in the same internment camp, as also were Prof. Van der Klaauw, and Koningsberger, the Utrecht botanist, successor of Went. A new star in the sky of animal psychology is A. Kortlandt, a young fellow, very clever, very original, very 'cormorant-minded'; for years he has lived among the Lekkerkerk cormorants, day and night, most of the time in a hide in the nest-trees, where he often stayed for one or more weeks, day and night continuously, receiving his food by a 'téléférique' (*Drahtseilbahn*).

Kluyver, the starling man, is all right; he had to leave Wageningen in September 1944, and his house was badly damaged, but he managed to save all the notes of his extensive study on the great tit, and most of his books, and has recently returned. The Government Phytopathological Service, where Kluyver was the ornithologist, has been absolutely ruined by the Germans. All records and files have been burned, as well as the library, one of the many instances of the enormous setback caused by the War. Sirks, Hazelhoff, Dijkgraaf (nephew and pupil of Von Frisch), Raven, Krijgsman, my brother L. Tinbergen, Ihle, De Beaufort are all right. Ihle very nearly died of starvation. Owing to the very limited possibilities of travelling and writing (no trains; cycling only possible during some hours of the night, to avoid the German slave-hunters), we heard such things mostly too late to help each other. De Burlet, much to our regret, has been co-operating with the Germans. He has fled and nobody knows where he is. Hirsch, who was a German, seems to be in Germany.

You may wonder whether we will have time to resume 'pure' scientific research, now that all kinds of reconstruction work will demand so much of our energy. I am sure that we will succeed in keeping part of our time for research.

From Dr. Buzzati-Traverso:

It has been possible for myself and some of my students to carry out a good deal of work (largely published in Italy) on the population genetics of various European species of *Drosophila*, and on induced chromosome mutations. The work was planned jointly with Timoféeff-Ressovsky, in whose Institute in Berlin I worked for five months in 1942. (The last news I had of Timoféeff-Ressovsky was from Hans Bauer in November 1944, to say that he was still working in Berlin. Bauer was then working near Tübingen, where the whole Kaiser Wilhelm Institut für Biologie had been transferred, after being slightly damaged in the early bombing of Berlin.) In Italy the work was done at the University of Pavia. As soon as possible after the Italian armistice, I transported everything I could from Pavia to the Istituto Italiano di Idrobiologia at Pallanza, and thus was saved from destruction a collection of more than two hundred stock cultures of *Drosophila*. This, I believe, is the only collection of *Drosophila* stocks surviving in continental Europe outside the U.S.S.R.

The Istituto Italiano di Idrobiologia was founded in 1939. It is a private foundation with two main laboratories, the principal at Pallanza, the other at Varenna on Lake Como. This is a research institute devoted to the study of problems of lake biology and of limnology. The director, Prof. Edgardo Baldi, is interested in problems of freshwater biology which are of significance for more general biological questions; the Institute is largely concerned with problems of the biology of the animals of freshwater basins. During the last couple of years, a number of such questions have been investigated from the point of view of population genetics.

My stay here has shown me that the combination of field work and study with genetics is likely to be fruitful. Accordingly, Dr. Baldi and I have decided to set up a genetics department of the Institute, under my supervision. We have a number of able young men available for work in this field, including Dr. L. Carvalli, a brilliant worker in statistical genetics and biometry. Our financial prospects appear bright.

In 1943, Prof. Baldi organized a symposium, in which about a dozen biologists, palæontologists and geologists took part, on micro-evolution during the Pleistocene. We have also worked out plans for co-operative work in the mountains above Trieste and in the region of Monte Circeo between Rome and

Naples, though the political and military position has so far not permitted their realization.

Italian biology was not good even before the War, and has since become worse owing to the destruction of many university laboratories and libraries. We feel that there is not much to hope for immediately from the academic milieu, because on one hand the new Italian Government is facing much more urgent problems than university re-organization, and on the other hand many professors of biology are wholly out of sympathy with modern ideas in this subject, and unlikely to be removed from their posts. Accordingly, we believe that the only way to improve the level of biological research and to raise a new generation of modern-minded biologists is to have institutes outside the universities which, keeping the closest possible contacts with foreign laboratories, should introduce the methods and the approach which I have had the good fortune to know and to appreciate in the United States, in Britain, and in some German laboratories. We think that for the time being such extra-university institutes might be the Istituto di Idrobiologia, the Stazione Zoologica in Naples, and perhaps the Istituto do Sanità Pubblica in Rome, which includes well-known physicists, such as Edoardo Amandi, who are very much interested in biophysical problems.

The most urgent need for us now is to become acquainted with the scientific production of the Allied Nations during the last five years. We need books and journals concerning genetic, ecological and general biological problems, to make our existing library comprehensive and up to date.

I suppose that in connexion with any new international organization, some kind of committee for international scientific co-operation is likely to be set up.

Dr. Huxley has also added the following postscript containing further information which he has obtained while in Switzerland and France during September.

(1) *German Ornithology.* While in Switzerland, I was given a copy of a letter written on August 1 by Dr. Erwin Stresemann of Berlin, the leading continental ornithologist, to a Swiss colleague:

The centre of the city has been almost completely destroyed and has become a ghastly heap of rubble. Our museum, however, has not been too badly damaged and we have been doing repair work for some weeks, with a view to opening the collection to the public. Two rooms of the bird department were very badly damaged during an air raid on March 18, 1945, thus unfortunately destroying almost the entire scientific collection of stuffed birds of 1810–88, as it had not been possible to move these from their cases owing to lack of space and means of transport—for there are (or were) 25,000 specimens! I was, however, able to evacuate most of the types to safety, as well as the modern collection of skins and all the books. I have for some time been engaged in bringing these back to their old home and arranging the bird department as it used to be. I am being helped in this work by Mr. Hermann Grote, who has been appointed as my assistant. The important library of the Deutsche Ornithologische Gesellschaft and the stock of unsold journals (*J. Ornithologie, Ornith. Monatsberichte*, etc.) have also been saved.

As we in Berlin are cut off from the world, I still know little about the fate of ornithologists in other parts of Germany. Dr. Oskar Heinroth died of pneumonia on May 31, 1945, consequent upon many nights spent in an air-raid shelter during the heavy raids of March and April—an irreplaceable loss. No news of Schuster. Dr. Otto Schnurre visited me a short time ago: he is now *kommisarischer* director of the Berlin City Library. Dr. E. Schütz wrote from Danzig last March, when that town was encircled and being attacked by the Russians—what may his fate have been? Dr. F. Tischler has remained in East Prussia. There is no news at all of the numerous Silesian ornithologists. The bird observatories of Heligoland and Rossitten are probably things of the past—for all time. I cannot at the present moment say whether I shall ever be able to re-start the *J. Ornithologie* and the *Ornith. Monatsberichte*; for the time being their resumption is unthinkable.

That great pioneer in animal psychology, Prof. Konrad Lorenz, was last summer reported missing near Vitebsk, probably killed; he was working as a doctor in a front-line hospital.

I expect that professional circles abroad will be interested to hear how the War and the collapse of Germany have affected German ornithology. I dare not think that it has disappeared for ever, and as long as I am able to do so I will devote all my energies to it, so that it may, at some future time, rise phœnix-like from its ashes. . . .

P.S.—The ringing records of the bird observatory at Rossitten were removed to Central Germany in time, and I expect that they are safe and can be used again in the future.

It may be recalled that Dr. Stresemann gave active help and encouragement during the War to two young British prisoner-of-war ornithologists, who organized groups in their prison camps to study the detailed behaviour of certain bird species. We may shortly expect the publication of their valuable data, obtained in circumstances that must be unprecedented.

(2) *German Genetics.* Through Prof. Boris Ephrussi of Paris I heard the welcome news that Dr. Timoféeff-Ressovsky, the eminent Berlin geneticist of Russian origin, has made satisfactory arrangements with the Russian authorities to continue his work in the U.S.S.R., and has already left Berlin with most of the staff and equipment of his Institute.

(3) *General Biology in Germany.* Inquiries in zoological circles in Switzerland elicited the following facts concerning German and Austrian biologists.

Hans Baur (Berlin), M. Henze (previously of Innsbruck), E. Rotmann (Cologne Vogt) and probably A. Kühn are alive. Von Buddenbrock, the well-known comparative physiologist, was demoted (*strafversetzt*) from Halle to Vienna in 1942 because of his general opposition to Nazi ideas, and was thence evacuated by the Americans with many other men of science to the American zone in Germany, where (in late August of this year) he was in grave financial straits and was not allowed to receive or send correspondence to foreign countries. The third volume of his great book on comparative physiology, dealing with hormones, is now in slip proof, and he has begun writing the fourth volume. As it is probably impossible for him to return to Vienna, it would seem highly desirable for this eminent and non-Nazi man of science to be given a post, in Germany or elsewhere, as soon as possible.

A. Penners of Vienna was very badly treated by the Nazis, and was probably dismissed from his post.

He attempted unsuccessfully to go to Switzerland before the outbreak of the War. His present whereabouts are uncertain. Ries, Wettstein and probably Seidel are dead. K. Henke and E. v. Holst (Göttingen), Paula Hertwig (Berlin), Hans Nachtsheim and Otto Warburg (Berlin-Dahlem) appear to have been alive at the end of the War, but no news of them has since been received. J. Haemmerling moved from Berlin-Dahlem to the Institut für Seenforschung on the Lake of Constance, but nothing has recently been heard from him.

(4) *Hungary and Czechoslovakia.* I have just heard through the Red Cross that Dr. Alexander Wolsky, the zoologist at the Biological Research Station at Tihany, is alive and well (and also his family) and that the Research Station is undamaged.

I have also heard that Prof. Jan Belehradek, one-time professor of zoology and later rector of the Karlovy University of Prague, is well, though he was imprisoned in a concentration camp for a considerable period.

Those who knew Dr. Wolsky and Prof. Belehradek when they were doing research in London in the '30's will be especially glad to hear this good news of them.

RESEARCH IN THE U.S.S.R. ON THE PHYSIOLOGY OF VISION

THE physiology of vision has always held a peculiar fascination for the physiological theorist, but recently the urgency of immediate practical problems, brought to a focus by the War, has led to a renewed and more direct approach both in this country and abroad. Recent Russian work in this field is published in *Problemy Physiologitchesky Optiky*, 2 (Moscow, 1944), which contains sixteen papers from eleven different laboratories. The papers are in Russian, but a generous English abstract of each is given.

Dealing first with work of immediate practical application, V. G. Samsonova has studied the influence of size of image, central brightness, ratio of central to peripheral brightness on the visual discrimination time, and has constructed nomograms from which optimum conditions of lighting for factories, etc., can be computed. O. P. Kholmskaya has measured the visibility of traffic lights against a black screen of varying size. The minimum size of screen for optimum visibility is one which subtends an angle of 12′; when the subtended angle is less than 3′ visibility is worse than with no screen at all. C. I. Krol finds that with several stimuli in the visual field and the total area of stimulation kept constant, the sensitivity of the eye varies inversely as the number of stimuli. S. V. Kravkov records changes in visual acuity resulting from auditory stimulation, and O. A. Dobriakova finds that various extraneous stimuli increase the critical frequency for flicker at the red end of the spectrum and decrease it at the blue end; there is a peak of increase in the orange-red and of decrease in the blue-green and an intermediate neutral zone in the yellow.

Turning to more fundamental researches, N. I. Pinegin has made a detailed quantitative study of the absolute sensitivity of the eye in the ultra-violet; at 365μ the eye is 11,000 times less sensitive than at 546μ, and the lower limit of vision is 302μ (Goodeve, Lythgoe and Schneider recently placed the lower limit at 309μ). Evidence is provided that the effects were due to direct retinal stimulation at this wavelength and were not the result of fluorescence in the eye media. M. N. Livanov has studied action potentials in the visual cortex and lateral geniculate body with the electroencephalograph. P. I. Spielberg has recorded action currents from the human eye by means of special electrodes applied to the eyeball; the method is fairly simple and may prove useful in ophthalmic practice. A. I. Bogoslovsky has investigated the response of the human eye to electrical excitation. Bogoslovsky has also found that in dark adaptation, while the excitability of the retina increases, that of the visual cortex decreases and the two seem to be reciprocally related.

When a coloured object is viewed at increasing distances, a point is reached (when the subtended angle is 10–20′) at which the colour changes in a characteristic fashion. B. N. Kompaneisky has studied these colour changes and concludes that the results can best be interpreted on a classical trichromatic theory of colour vision. The method also provides a sensitive test of colour vision; there are some variations even among normal individuals, and colour defectives are readily identified.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

THE DISCOVERY OF X-RAYS
50TH ANNIVERSARY COMMEMORATION PROGRAMME

Medical Meeting

Saturday, November 10

At the Institution of Electrical Engineers, at 2 p.m.

Scientific Meeting

Saturday, November 10

At the Royal Institution, at 10 a.m.

Historical Reviews

Saturday, November 10

At the Institution of Electrical Engineers, at 3.30 p.m.

Saturday, November 10

BIOCHEMICAL SOCIETY (at the London School of Hygiene, Keppel Street, London, W.C.1), at 11.30 a.m.—Discussion on "The Chemical Basis of Cell Structure and Function" (to be opened by Dr. J. F. Danielli and others).

IRON AND STEEL INSTITUTE (joint meeting with the SCOTTISH BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN) (at the Royal Technical College, George Street, Glasgow), at 3 p.m.—Mr. Basil Gray: "The German Steel Foundry Industry".

Monday, November 12

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W.7), at 5.30 p.m.—Prof. H. W. Ahlmann: "Summary of Glaciological Researches, 1918–1940".

Tuesday, November 13

CHADWICK PUBLIC LECTURE (at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Mr. F. C. Vokes: "The Modern System of Sewage Disposal and the Methods and Materials Employed" (Bossom Gift Lecture)*.

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. A. Müller: "50th Anniversary of the Discovery of X-Rays", (ii) "After the Discovery of X-Rays".

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 5.30 p.m.—Discussion on "Forward Psychiatry in the Army" (to be opened by Lieut.-Colonel H. A. Palmer, Major C. Kenton, Lieut.-Colonel H. B. Craigie and Lieut.-Colonel T. F. Main).

BRITISH ASSOCIATION OF CHEMISTS, NORTHERN SECTION (in the Chemistry Lecture Theatre, King's College, Newcastle-upon-Tyne), at 7 p.m.—Mr. R. Booth: "The Development and Properties of Safety Glass".

Wednesday, November 14

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. A. C. Hartley: "Operation PLUTO".

INSTITUTE OF PETROLEUM (at 26 Portland Place, London, W.1), at 5.30 p.m.—Flight-Lieut. E. Mikolajewski: "Investigation of Piston Ring Sticking in High Duty Aero Engines".

INSTITUTION OF ELECTRICAL ENGINEERS, TRANSMISSION SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. W. J. Nicholls: "Recent Progress in the Design of the High-Voltage Overhead Lines of the British Grid System".

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Neville Hall, Westgate Road, Newcastle-upon-Tyne), at 6 p.m.—Mr. S. G. Button: "U.H.F. Aerial Systems".