thus the products of their activity must issue through evolutionary processes; what they will become after millions of generations must be determined so soon as these "idioblasts" combine as the first cell. If, however, we are to assume that the hereditary qualities of "idioblasts" can be eliminated by environment—as we must assume if we attempt to combine evolution with epigenesis—I reply, as in my earlier proposition, we have no need for "idioblasts" or any other "hereditary unit." All we then need for a theory of heredity is some plastic *primordium* and environment. Then, as such *primordium* would have no hereditary predisposition, there would be no room for predeterminism, and it would remain for ingenious theorists in love with epigenesis and the tape-measure system of estimating the cosmos, to explain the persistence of types under variable environment, and the differentiation of types under identical environment.

I can appreciate the eagerness of the "mechanical school" to welcome any loophole of escape from predeterminism. A genuine epigenetic theory is, no doubt, their great desideratum. If they "won't be happy till they get it," I venture to predict that they are doomed to a lengthened spell of dumps! The main issue raised by Hertwig in "The Cell," is: evolution or epigenesis? He tries to accept both, basing epigenesis on evolution. Thereby, in my opinion, he stultifies both doctrines. All biologists, so far as I am aware, start their theories from the basis of differentiated units. Equally they all evade the attempt to account for the differentiation. This omission I have endeavoured to rectify in "Rhythmic Heredity" (Williams and Norgate).

H. CROFT HILLER.

A Sound-producing Insect.

IN your issue of June 13, Mr. S. E. Peal speaks of a lepidopterous insect in Assam which makes a tapping noise when flying. His description so closely resembles an insect in Gorakhpur, that I think it must be identical or closely allied.

The alar expanse is about three inches. The wings are broad, not indented, of a very dark chocolate-brown colour on both sides, with one small yellowish-brown blotch on the costa of fore-wing on upper surface. The body is thin, like a butterfly, but the antennæ are not clubbed. It is apparently a Geometer or slender-bodied Bombyx. It flies in the darkest parts of woods, just as twilight is settling into night, and is very hard to see when standing up. By lying down, so as to get the sky as a background, it is easily visible. It cannot be netted in the ordinary way, as the eye cannot follow it, but by standing still till one is heard near, and then striking in the direction of the sound, one may sometimes be successful. I first succeeded in striking one down with my "solah topi"; afterwards I netted two, and brought them home alive, to see how the noise was made. The sound is a sort of clicking, which may be fairly imitated by striking the nails of the thumb and fore-finger together. From the thorax, between the bases of the wings, a stiff bristle (like a pig's) projects about a quarter of an inch. The noise is made by this bristle catching in the hind-margin of the fore-wings and the costal margin of the hind-wings. I fancy it must be of a warning character, as if the insect is eatable, it would help to enable bats and birds to find it. I think I have noticed that the insect is attracted by imitating the clicking sound with the nails, but could not satisfy myself on this point.

J. R. HOLT.

A FEW MORE WORDS ON THOMAS HENRY HUXLEY.

TWO scenes in Huxley's life stand out clear and full of meaning, amid my recollections of him, reaching now some forty years back. Both took place at Oxford, both at meetings of the British Association. The first, few witnesses of which now remain, was the memorable discussion on Darwin in 1860. The room was crowded though it was a Saturday, and the meeting was excited. The Bishop had spoken; cheered loudly from time to time during his speech, he sat down amid tumultuous applause, ladies waving their handkerchiefs with great enthusiasm; and in almost dead silence, broken merely by greetings which, coming only from the few who knew, seemed as nothing, Huxley, then well-known unknown outside the narrow circle of scientific

workers, began his reply. A cheer, chiefly from a knot of young men in the audience, hearty but seeming scant through the fewness of those who gave it, and almost angrily resented by some, welcomed the first point made. Then as, slowly and measuredly at first, more quickly and with more vigour later, stroke followed stroke, the circle of cheers grew wider and yet wider, until the speaker's last words were crowned with an applause falling not far short of, indeed equalling, that which had gone before, an applause hearty and genuine in its recognition that a strong man had arisen among the biologists of England.

The second scene, that of 1894, is still fresh in the minds of all. No one who was present is likely to forget how, when Huxley rose to second the vote of thanks for the presidential address, the whole house burst into a cheering such as had never before been witnessed on any like occasion, a cheering which said, as plainly as such things can say: "This is the faithful servant who has laboured for more than half a century on behalf of science with his face set firmly towards truth, and we want him to know that his labours have not been in vain." Nor is any one likely to forget the few carefully chosen, wise, pregnant words which fell from him when the applause died away. Those two speeches, the one long and polemical, the other brief and judicial, show, taken together, many of the qualities which made Huxley great and strong.

Among those qualities perhaps the most dominant, certainly the most effective as regards his influence on the world, were on the one hand an alertness, a quickness of apprehension, and a clear way of thinking, which, in dealing with a problem, made him dissatisfied with any solution incapable of rigid proof and incisive expression, he seemed always to go about with a halo of clear light immediately around him; and, on the other hand, that power of foreseeing future consequences of immediate action which forms the greater part of what we call sagacity. The former gave him his notable dialectic skill, and mark all his contributions to scientific literature; the latter made him, in addition, an able administrator and a wise counsellor, both within the tents of science and beyond. These at least were his dominant intellectual qualities; but even more powerful were the qualities in him which though allied, we distinguish as moral; and perhaps the greater part of his influence over his fellows was due to the fact that every one who met him saw in him a man bent on following the true and doing the right, swerving aside no tittle, either for the sake of reward or for fear of the enemy, a man whose uttered scorn of what was mean and cowardly was but the reciprocal of his inward love of nobleness and courage.

Bearing in mind his possession of these general qualities, we may find the key to the influence exerted by him on biological science in what he says of himself in his all too short autobiographic sketch, namely, that the bent of his mind was towards mechanical problems, and that it was the force of circumstances which, frustrating his boyish wish to be a mechanical engineer, brought him to the medical profession. Probably the boyish wish was merely the natural outcome of an early feeling that the solution of mechanical problems was congenial to the clear decisive way of thinking, to which I referred above, and which was obviously present even in the boy; and that it was not the subject-matter of mechanical problems, but the mode of treating them which interested him, is shown by the incident recorded by himself, how when he was a mere boy a too zealous attention to a post-mortem examination cost him a long illness. It is clear that the call to solve biologic problems came to him early; it is also clear that the call was a real one; and, as he himself has said, he recognised his calling when, after some years of desultory reading and lonely irregular mental activity, he came under the influence of Wharton Jones at Charing Cross Hospital. That made him a biologist, but con-

firmed the natural aptitude of his mind in making him a biologist who, rejecting all shadowy intangible views, was to direct his energies to problems which seemed capable of clear demonstrable proof. In many respects the biologic problems which lend themselves most readily to demonstrable solutions capable of verification are those which constitute what we call physiology; and if at the time of his youth the way had been open to him, Huxley would probably have become known as a physiologist. But at that time careers for physiologists were of the fewest. His master, Wharton Jones, a physiologist of the first rank, whose work in the first half of this century still remains of classic value, had been driven to earn his bread as an ophthalmic surgeon, and an even greater physiologist, William Bowman, was following the same course. There was no opening in physiology for the young student at Charing Cross, and he was driven by stress of circumstances to morphological rather than to strictly physiological problems; but it was not until long after, when he had achieved eminence as a morphologist, that he finally abandoned his old wish to hold a physiological chair.

Looking back on the past, we may now be glad that circumstances were against his wishes; for (though in every branch of science there is need at all times of a great man) there was at the middle of the century, in the early fifties, a special need in morphology for a man of Huxley's mould. Richard Owen was then dominant, and it is an acknowledged feature of Owen's work that in it there was a sudden leap from most admirable detailed descriptive labour to dubious speculations, based for the most part on, or at least akin to, the philosophy of Oken. Of the "new morphology" in which Johannes Müller was leading the way, and the criteria of which had been furnished by the labours of von Baer, there was then but little in England save, perhaps, what was to be found in the expositions of Carpenter. Of this new morphology, by which this branch of biology was brought into a line with other exact sciences, and the note of which was not to speculate on guiding forces and on the realisation of ideals, but to determine the laws of growth by the careful investigation, as of so many special problems, of what parts of different animals, as shown among other ways by the mode of their development, were really the same or alike, Huxley became at once an apostle. His very first work, that on the *Medusæ*, wrought out amid the distractions of ship life, written on a lonely vessel ploughing its solitary way amidst almost unknown seas, away from books and the communion of his fellow workers, bears the same marks which characterise his subsequent memoirs; it is the effort of a clear mind striving to see its way through difficult problems, bent on holding fast only to that which could be proved. This is not the occasion to insist in detail on the value of the like morphological work which he produced in the fifties and the sixties, or to show how he applied to other forms of animal life, to echinoderms, to tunicates, to arthropods, to molluscs, and last though not least to vertebrates, the same method of inquiry which guided the work on the *Medusæ*. Nor need I dwell on the many valuable results which he gained for science by attacking in the same spirit the problems offered by the remains of extinct forms. Moreover, he strengthened the effect of his own labours by admirable expositions of the results of others. Further, unlike his great predecessor who formed no school and had few if any disciples, it was Huxley's delight to hold out his hand to every young man whom he thought could profit by his help, and before many years were over his spirit was moving in the minds of many others. Thus it came about that during the latter half of this century, owing largely to Huxley's own labours and to the influence which he exerted not only in England but abroad, there has been added to science a large body of morphological truths, truths which have been demonstrated and must

remain, not mere views and theories which may be washed away.

The excitement of the Darwinian controversy, with its far-reaching issues, has been apt to make us forget how great has been the progress of animal morphology during the past half century. Undoubtedly the solution of special problems touching animal forms, and the great theory of Natural Selection through the Struggle for Existence have been closely bound together: the special learning has furnished support for the general theory, and the general theory, besides strongly stimulating inquiry, has illumined the special problems. But the two stand apart, each on its own basis; and were it possible to wipe out, as with a sponge, everything which Darwin wrote, and which his views have caused to be written, there would still remain a body of science touching animal forms, both recent and extinct, acquired since 1850, of which we may well be proud. In the gaining that knowledge Huxley, as well by his own labours as by his influence over others, stands foremost, Gegenbaur being almost his only peer; and had Huxley done nothing more, his name would live as that of one of the most remarkable biologists of the present century.

As we all know, he did much more; his influence on England and on the world went far beyond that of his purely scientific writings. But when we reflect that a hundred years hence the image of the man as he went to and fro among men, so bright and vivid to-day, will have become dim and colourless, a shadow as it were, and that then the man will be judged mainly by the writings which remain, we must count these writings as the chief basis of his fame. And, though we may think it possible that the world of that day, much that is unwritten having been forgotten, may find it in part difficult to understand how great a power Huxley was in his time, the lapse of years will, we may be sure, in no way lessen, it may be will heighten, the estimate of his contributions to exact science.

As we all know, he did much more. To the public outside science he first became known as the bold, outspoken exponent and advocate of Darwin's views, and indeed to some this is still his chief fame. There is no need here to dwell on this part of his work, and I speak of it now chiefly to remark that the zeal with which he threw himself into this advocacy was merely a part of the larger purpose of his life. Science, or, to use the old phrase of the Royal Society, Natural Knowledge, had a two-fold hold on Huxley. On the one hand he felt deeply all the purely intellectual, and if we may use the word, selfish joys of fruitful progressive inquiry after truth. This was dominant in his early days, and to it we owe the long list of valuable researches, of which I just now spoke, and which followed each other rapidly in the fifties and the sixties. On the other hand, feeling deeply, as he did, his duties as a citizen of the world, science laid hold of him as being the true and sure guide to conduct man in all his ways; and this latter working of science in him, evident even in early days (witness his Address to Working Men at St. Martin's Hall in 1854), grew stronger and stronger as the years went on, until at last it took almost entire possession of him. To him, indeed, it may be said, science was all in all. He saw, as others see, in science a something which is broadening and strengthening human life by unceasingly bending nature to the use of man, and making her resources subservient to his desires; he saw the material usefulness of science, but he saw something more. He saw also, as others see, in science a something in which the human mind, exercising and training itself, makes itself at once nimble and strong, and dwelling on which is raised to broad and high views of the nature of things; he saw in science a means of culture, but he saw something more. He saw in science even as it is, and still more in science as it will be, the sure and trustworthy

guide of man in the dark paths of life. Many a man of science goes, or seems to others to go, through the world ordering his steps by two ways of thinking. When he is dealing with the matters the treatment of which has given him his scientific position, with physical or with biological problems, he thinks in one way; when he is dealing with other matters, those of morals and religion, he thinks in another way; he seems to have two minds, and to pass from the one to the other according to the subject matter. It was not so with Huxley. He could not split himself or the universe into two halves, and treat the one and the other half by two methods radically distinct and in many ways opposed; he applied the one method, which he believed to be the true and fruitful one, to all problems without distinction. And as years came over him, the duty of making *his* view clear to others grew stronger and stronger. Relinquishing, not without bitter regret, little by little, the calm intellectual joys of the pursuit of narrower morphological problems, he became more and more the apostle of the scientific method, driven to the new career by the force of a pure altruism, not loving science the less but loving man the more. And his work in this respect was a double one; he had to teach his scientific brethren, at least his biologic brethren, the ways of science, and he had to teach the world the works of science. It was this feeling which, on the one hand, led him to devote so much labour to the organisation of biologic science in order that his younger brethren might be helped to walk in the straight path and to do their work well. It was this feeling, on the other hand, which made him urgent in the spread of the teaching of science. It was this, and no vain love of being known, which led him to the platform and the press. The zeal with which he defended the theory of Natural Selection came from his seeing the large issues involved; to him the theory was a great example of the scientific method applied successfully to a problem of more than biologic moment; while the fierceness of his advocacy was a natural expression of resentment on the part of one who saw a scientific conclusion, gained with unstinted pains and large reasoning, judged contemptuously by men who knew nothing of science according to methods in which science had no part.

Science, under this aspect, is a part of what is sometimes called philosophy; and though Huxley felt, in common with others, and felt deeply the pleasures of the intellectual wrestler, struggling with problems which, seemingly solved and thrown to the ground, spring up again at once in unsolved strength, it was not these pleasures alone which led him, especially in his later years, to devote so much time and labour to technical philosophic studies. He hoped out of the depths of philosophy to call witnesses to the value of the scientific method. Indeed, nearly all the work of the latter part of his life, including the last imperfect fragment, written when the hand of disease which was to be the hand of death was already laid upon him, and bearing marks of that hand, was wrought with one desire, namely to show that the only possible solutions of the problems of the universe were such as the scientific method could bring. This was at the bottom of that antagonism to theology which he never attempted to conceal, and the real existence of which no one who wishes to form a true judgment of the man can ignore. He recognised that the only two consistent conceptions of man and the universe were the distinctly theologic one and the scientific one; he put aside as unworthy of serious attention all between. He was convinced that the theologic conception was based on error, and much of his old age was spent in the study of theologic writings whereby he gathered for himself increasing proof that there was no flaw in the judgment which had guided his way from his youth upward. Not only so, but he was no less convinced that, owing to what he

believed to be the essential antagonism of the theologic and the scientific methods, the dominance of the former was an obstacle to the progress of the latter. This conviction he freely confessed to be the cause of his hostile attitude; he believed it to be the justification of even his bitter polemics.

But while on the objective side his scientific mode of thought thus made him a never-failing opponent of the theologic thought of every kind, a common tie on the subjective side bound him to the heart of the Christian religion. Strong as was his conviction that the moral no less than the material good of man was to be secured by the scientific method alone, strong as was his confidence in the ultimate victory of that method in the war against ignorance and wrong, no less clear was his vision of the limits beyond which science was unable to go. He brought into the current use of to-day the term "agnostic," but the word had to him a deep and solemn meaning. To him "I do not know" was not a mere phrase to be thrown with a light heart at a face of an opponent who asks a hard question; it was reciprocally with the positive teachings of science the guide of his life. Great as he felt science to be, he was well aware that science could never lay its hand, could never touch, even with the tip of its finger, that dream with which our little life is rounded, and that unknown dream was a power as dominant over him as was the might of known science; he carried about with him every day that which he did not know as his guide of life no less to be minded than that which he did know. Future visitors to the burial-place on the northern heights of London, seeing on his tombstone the lines—

"And if there be no meeting past the grave,
If all is darkness, silence, yet 't is rest.
Be not afraid ye waiting hearts that weep,
For God still 'giveth his beloved sleep,'
And if an endless sleep He wills,—so best"—

will recognise that the agnostic man of science had much in common with the man of faith.

There is still much more to say of him, but this is not the place to say it. Let it be enough to add that those who had the happiness to come near him knew that besides science and philosophy there was room in him for yet many other things; they forgot the learned investigator, the wise man of action, and the fearless combatant as they listened to him talking of letters, of pictures, or of music, always wondering which delighted them most, the sure thrust with which he hit the mark whatever it might be, or the brilliant wit which flashed around his stroke. And yet one word more. As an object seen first at a distance changes in aspect to the looker-on who draws nearer and yet more near, features unseen afar off filling up the vision close at hand, so he seemed to change to those who coming nearer and nearer to him gained a happy place within his innermost circle; his incisive thought, his wide knowledge, his sure and prompt judgment, his ready and sharp word, all these shrunk away so as to seem but a small part of him; his greater part, and that which most shaped his life, was seen to be a heart full of love which, clinging round his family and his friends in tenderest devotion, was spread over all his fellow men in kindness guided by justice.

M. FOSTER.

DR. FRIEDRICH TIETJEN.

AT a time when astronomical knowledge is being extended at so rapid a rate, and in so many directions, as has been the case during the last few years, it is natural and right that the highest honour should be paid to those astronomers to whose genius and industry are due discoveries possible on account of original suggestion