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 this 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 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 belovèd 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

or ingenious execution. But at the same time, and on the other hand, there is no small danger that we may fail to give proper recognition to those other astronomers whose lives, unmarked by brilliant achievements, have been devoted to labours which are none the less valuable because they have been accomplished while quietly pursuing recognised lines, and are therefore devoid of conspicuous originality. In particular, the work of computation and arithmetical reduction of observations, without which the observations themselves either cannot be made or must remain almost entirely useless, is apt to fall into disrepute, as being wholly mechanical and unenterprising. This is certainly to be regretted; for just as a victorious general marching forward in the enemy's country must depend for his very safety on the fidelity and capacity of those officers who hold the conquered territory, so our scientific knowledge is liable to become disconnected and fragmentary unless we have capable men ready to perform the task of computing from the observations, and co-ordinating the results achieved in more exciting spheres of scientific work. If the pursuit of such unostentatious work lead to the effacement of the worker, our gratitude should be even all the greater for the self-denial exhibited and practised. Of such a man we have recently had to lament the loss, owing to the sad death of Dr. Tietjen, of Berlin.

Friedrich Tietjen was born in Oldenburg, in the year 1834; we therefore lose his services at the comparatively early age of sixty-one. He studied mathematics and astronomy at Göttingen, and subsequently at Berlin, with which latter city he has been continuously connected. In 1861, he became attached to the staff of the Berlin Observatory, and in one or other capacity this connection remained unbroken till the time of his death. He was appointed Professor of Astronomy in the University of Berlin, and Director of the *Recheninstitut*, allied to the Berlin Observatory. In his earlier career, Dr. Tietjen occupied himself with the observations of comets and asteroids, discovering in this way the asteroid *Semele*. To his activity and devotion the pages of the *Astronomische Nachrichten* abundantly testify. He is also known as the calculator of several cometary orbits, and also of the orbits and ephemerides of many asteroids. Some twelve years later, Dr. Tietjen became superintendent of the *Berliner Astronomisches Jahrbuch*, and his reputation in that capacity is not less assured than that of Dr. Powalky, who had preceded him in that office. As official director he paid great attention to shortening the labour of the necessary calculations as far as possible. Some of his methods have been published, others are not so well known, ill-health having prevented him from giving them to the world. Of the value and of the accuracy of this publication under the superintendence of Dr. Tietjen it is unnecessary to speak here, for it is sufficiently well known. Probably his most useful work was that done in superintending the preparation of the ephemerides of the small planets, the continual and rapid increase in the number of which, while it enormously increased his work, had likewise the effect of lessening the interest in this class of discoveries. While the national almanacks of other countries practically discontinued the publication of this class of ephemerides, Dr. Tietjen loyally struggled to supply sufficient information to ensure the observation of the small planets. Those who have attempted the determination of the mass of Jupiter from the perturbations of these bodies, and similar kinds of work, know how to appreciate the labours of Dr. Tietjen, by which the continuous observation from opposition to opposition has been rendered possible.

This skilled mathematician and remarkably facile computer died at Berlin, on June 21, deeply lamented by his numerous friends, and regretted by many who have profited by the devotion of his quiet unambitious life to the service of astronomy.

THE MAXIM FLYING MACHINE.

ON Friday, July 5, a large party of scientific men paid a visit, by invitation of Mr. Hiram Maxim and Mr. Brodrick Cloete, to Baldwyns Park, Bexley, to witness a trial of the celebrated flying machine, and the latest development in the direction of mechanical flight.

The invitations were carefully distributed among those who were competent to judge of the magnitude of the task to be attempted, and who were prepared to examine closely the ingenious mechanical details by which it was clearly demonstrated that the machine had ample power to lift itself off the ground, carrying with it a supply of fuel and water, and a crew for the navigation.

An unscientific crowd of spectators might have become unmanageable, and might have developed iconoclastic tendencies (like the Weser boatmen with Denis Papin's original steam vessel) when the machine did not take to flight immediately and disappear from their astonished gaze.

> "As lewed people demeth comunly
> Of thinges that ben maad more subtilly
> Than they can in her lewednes comprehende
> They demen gladly to the badder ende——"

But the Bexley machine is purposely designed of extreme size, with the intention of thoroughly testing and elaborating the details of the mechanism, and of measuring the lifting power, within immediate reach of a workshop and skilled mechanics, more than of actually taking to the air; this will probably be first attempted with a much smaller machine, capable of lifting one man of jockey-like proportions, and mounted on a boat on a lake, so that short flights, like those of a flying fish, can be attempted for initial practice.

The lifting force of the machine is measured automatically as it runs along a railway track about half a mile in length, as shown in the accompanying illustration (Fig. 1), and the machine is prevented from taking to flight by wheels running underneath the outer wooden rails, seen in the figure; for much yet remains to be done in the way of practice in vertical steering before taking leave of the earth; the chief difficulties of the Aviator beginning when he wishes to descend and alight on the ground again.

Chaucer did not realise the difficulties of the problem when describing so jauntily the Bronze Horse in the Squieres Tale:—

> "This same stede shall bere yow ever-more
> With-outen harm, til ye be ther yow leste,
> Though that ye slepen on his bak or reste;
> And turne ayeyn, with wrything of a pin."
>
> "But whan yow list to ryden any-where,
> Ye moten trille a pin, stant in his ere——"
> "Bid him descend, and trille another pin,"
> "Trille this pin, and he wol vanishe anon."

The "wrything of a pin" is not inapt in describing the dominating gyrostatic brain of the Aviator, designed by Mr. Maxim to perform the vertical steering automatically.

The Bexley machine, complete with the water, naphtha fuel, and crew of three men on board, weighs 8000 lb.; and running at forty miles an hour with a pressure of 275 lb. per square inch, the engines develop 360-horse power, the thrust of the screws is 2000 lb., and the lifting effect of the aeroplanes and wings, 4000 square feet in area, is 10,000 lb.

A thrust of 2000 pounds at 45 miles an hour gives 240 thrust horse-power; or, with a speed of advance of the screw of 60 miles an hour, 320 indicated horse-power.

The total projected disc area of the screws is 500 square feet, each screw being nearly 18 feet in diameter, with a pitch of 16 feet; and thus requiring 330 revolutions a minute to give a speed of advance of 60 miles an hour.