

chequered life, as stated in this notice. It is obvious that Cormack never got into that steady sort of practice which fills the purse. His journalistic work was an impediment rather than a help to him. It is not easy to see why he did not succeed in practice, especially at Putney, where he had a good opening. It was not want of professional knowledge; his writings show that this was full and extensive. It was nothing wrong with his *morale* or his relations with religion, for although he did not carry a broad phylactery, or enlarge the border of his garments, he was essentially a quietly and unobtrusively Christian man. It is neither pleasing nor profitable to pursue this theme, and one can only fall back upon the trite expression of the country of his adoption, that he wanted the "*Je ne sais quoi*," the absence of which has hindered the success of many a man as full of erudition and observing power as himself.

Cormack was a warm and steadfast friend, and the writer of these lines desires to record that this was the constant relation to himself of the subject of this obituary notice.

SIR CHARLES WYVILLE THOMSON, F.R.SS. L. and E. By Peter Redfern, M.D. Lond.

Charles Wyville Thomson was born on the 5th of March 1830 at Bonyde, a small property in Linlithgowshire, which had long been in his family. His father was the late Mr Andrew Thomson, who spent most of his life abroad as a surgeon in the service of the Honourable East India Company. His mother was Sarah Ann Drummond, the only daughter of Dr Wyville Smith, Inspector of Military Hospitals. His grandfather was a distinguished Edinburgh clergyman, and his great-grandfather was "Principall Clerke of Chancery" at the time of the Rebellion of 1745. His father was rather a strict disciplinarian, and expected to see successive distinctions at school and college following in the wake of the admirable education which he placed at the command of his son.

These were stirring times for Scotland. Unembarrassed by troubles from without, her people were continually struggling for intellectual advancement. They furnished and maintained schools

of the highest class in the larger towns, and such as offered classical training to the youth, in the whole length and breadth of the country, in preparation for the Universities. In Edinburgh, Glasgow, Aberdeen, and St Andrews, she gave university education to twice as large a proportion of her population as Prussia did; and it is not to be wondered at that her sons have distinguished themselves in every corner of the globe. In settling in the north of Ireland, they introduced order and liberty, manufactures and prosperity, and raised one of its towns at least to take its place amongst the most enterprising and prosperous in the United Kingdom, whilst they themselves neither required soldiers nor police for the maintenance of order and securing the advantages of the administration of just laws. These were the days of Thomson's youth.

The mother's fond affection for her son led her to anticipate his wishes—to supply his wants—and to present him to his father as almost faultless in every relation of his early life. The son's devotion to his parents led him to make many an effort for their gratification, no less than for his own success in life. His early training was at Merchiston Castle School, when it was under the management of Mr Charles Chalmers, brother of the famous divine. Mr Thomas Chalmers, of Longcroft, near Linlithgow, and son of the then proprietor of the school, stated at a meeting of the commissioners of supply for the county of Linlithgow, that “when young Thomson entered the school he himself had passed from being a scholar to the position of a master, and thus became Thomson's first teacher in some of those branches of science in which he afterwards became so eminent.” Mr Chalmers adds—“No doubt the lessons he received were of a very elementary description, still I may be allowed to recall with some satisfaction, if not pride, the happy early days of our intercourse, when, with botanical boxes or geological hammers in hand, we rambled on Saturday holidays, or in the long summer evenings, among the woods of Braid and Colinton, or over the uplands of the beautiful Pentland Hills, in search of some of the interesting flora or geological and mineral specimens in which the neighbourhood of Edinburgh so richly abounds,” and then describes the exultation and satisfaction with which they returned with any new or rare specimen after a long day's excursion. Mr Chalmers says that Thomson was a universal favourite with his

schoolfellows, and was highly esteemed by his teachers for his conscientious discharge of every duty.

Shortly after he had entered the University his desire to engage in original work began to show itself in his devotion to the study of botany and zoology. It was his original intention to graduate in medicine, but the attractions of biological science were too great to permit of his devoting any large amount of attention to the other subjects of medical study, and at length he gave up all idea of qualifying as a medical man or entering into medical practice. At this early period his desire to be free from the trammels of customary methods of study, and to trust to his own efforts, was well shown by the reply which Professor Balfour, then Professor of Botany, made to him on his soliciting a certificate of attendance on his class—"I will willingly testify to your knowledge of botany, but I cannot certify that you attended my class." This early formed spirit of self-reliance and determination to investigate natural objects themselves, rather than trust merely to the results of the observations of others, seems to have pervaded his life, and to have led to the urgent requests he continually made for aid to establish collections in public institutions, and at length to the appeal to the Government itself for the means of carrying out what became the most important work of his life, that of determining the physical and vital conditions which prevail at different depths of the ocean.

I first met Wyville Thomson at the house of my late dear friend, Professor J. H. Bennett, at the time of the meeting of the British Association in Edinburgh in 1850, when the friendship commenced which remained unbroken for a single hour during the whole of his life. I was greatly impressed with his knowledge of botany, and with the energy and determination in the pursuit of science of one who appeared to me to have the most tempting professional career open before him.

Dr Dickie had been removed from the University and King's College, Aberdeen, to the chair of Natural History in Queen's College, Belfast. Finding that Thomson had no disinclination to devote himself, for some time at least, to scientific work, I had the pleasure of recommending him for the vacant lectureship, and seeing him start on the career which ended so brilliantly but prematurely. In 1851 he was prevailed on to leave King's and to

lecture in Marischal College, Aberdeen, where he continued to study his favourite subjects and to teach botany until 1853, when he was selected by the Crown as the successor to the Rev. Wm. Hincks, F.L.S., in the chair of Natural History in Queen's College, Cork.

The charming flora and fauna of Aberdeen, which had been laboriously worked for years by Dr Dickie, who had indicated the spots where the most interesting specimens were to be met with, was open and ready for further examination by the more daring and speculative spirit of Thomson. It was not long before a visit to his study possessed the greatest attractions and charms. Around the room, on shelves, tables, and floor alike, there lay, in what would have seemed to a casual observer the most grotesque confusion, the treasures of description and illustration of the most eminent naturalists of the day and of former times. The shelves and mantelpiece were, shortly, crowded with selected and neatly preserved specimens of Polyzoa and sertularian zoophytes taken in the neighbourhood, picked off the fishermen's lines, or dredged up by Thomson himself; here and there lay heaps of plants already in their places in the herbarium, or in process of preparation for being preserved; and, what was more charming than all, there were bowls and dishes and aquaria of all kinds, containing the actual living specimens which were being examined, and of which the characters were rendered permanent by the naturalist-artist himself in the most beautifully executed drawings. Amidst all these signs of true scientific work there were indications of the enjoyment which the tenant of this sanctum himself derived from indulging in his natural tastes. The specimens of the most elegant forms were always in the foreground; there never failed to be seen two or three rare or beautiful flowers, made ten times more beautiful than ordinary by the tasteful way in which they were displayed, whilst the newest photographs or sketches of the glens or other scenery in the neighbourhood found a home on any unoccupied spots there chanced to be on the walls. Those who had the privilege of witnessing the progress of this happy life, of noticing how the varying forms of these elegant sertularians gradually proclaimed their mode of development, how their myriad medusoids were produced, at length set free, and then settled in life, under the observation of the loving intruder into their inner life, could not but wonder how time was obtained for all

this varied work, attended as it was with the enjoyment of the pleasures of social life, and with that of adding to those pleasures the charms of wit, of elegance, and manner of one who was equally at home, and even more happy, in the society of ladies and educated men than in the company of his home family of zoophytes, or other of the lower forms of living beings.

Thus two or three of the earlier years of the public life of Wyville Thomson were spent. They produced many papers of great interest, which were published in the *Annals of Natural History* and other periodicals, and gave birth to very noticeable philosophical speculations on the development of certain medusoid forms, startling many older naturalists, and only partially accepted by others, such as Johnston of Berwick-upon-Tweed, and Edward Forbes, who considered them too daring advances on what was then known of the modes of life of those beings.

On leaving Aberdeen, Thomson had secured a large number of sincere friends to whom his departure was a great loss. His kindness of heart and his many estimable social qualities had made him desired in every circle, whilst in both the colleges to which he had been attached he was looked upon as a rising naturalist, destined to attain great eminence as years advanced. The degree of LL.D. was conferred upon him by Marischal College, Aberdeen.

In Cork, to the duties of teaching botany, those of teaching zoology were added, and both were discharged with equal vigour and success. But other changes were awaiting him. Early in 1854 he married Jane, the elder daughter of Adan Dawson, Esq., deputy lieutenant of the county of Linlithgow, and proprietor of Bonnytown, the neighbouring estate to Bonsyde. As the friend of the bridegroom, I had the pleasure of participating in the great gathering of members of the county families, and of Thomson's numerous Edinburgh friends, to celebrate what was deemed a most auspicious union of two families, both held in high estimation by all who knew them. In the same year the chair of Mineralogy and Geology in Queen's College, Belfast, became vacant by the resignation of Professor Frederick M'Coy, who was elected to a professorship in the new University of Melbourne, and Thomson was then transferred from Cork to Belfast.

The studies incident on the occupation of the chair of

Mineralogy and Geology and the charge of the Natural History Museum, following in succession on the study of Botany and Zoology, the subjects of Thomson's former chairs, now completed his training as a Professor of Natural History. He devoted much time and attention to Palæontology, and thus, in comparing the old world forms with those at present existing, obtained much useful insight into the relations between them. Under his guidance the Museum of the College was greatly enlarged, especially in the departments of Zoology and Palæontology, and his efforts in this respect received the hearty co-operation of the president and vice-president. Specimens for teaching and for the enrichment of the museum were sought for everywhere, and properly arranged and classified. Whatever new objects possessed unusual interest were made the subjects of papers read before scientific societies, or published in the journals of the day. It was at this time that a paper appeared on a genus of Trilobites; this had been read before the London Geological Society. Another, on a fossil Cirriped, was published in the *Annals of Natural History*. One can well imagine the growing consciousness of power in dealing with fossil forms which Thomson's previous knowledge of the existing living forms gave him, and that, as the accumulation of specimens proceeded, the series would be seen to be in certain parts more or less complete, whilst in others it would be found wanting, and thus the necessity of further investigation would be pointed out. It was natural that, when he came to the collection and investigation of the numerous varieties of extinct forms of echinoderms, the eye which was always open to the charms of beauty should have been arrested, and that it should have occurred to him that what was needed for a complete understanding of them was a correct knowledge of everything which their living forms could teach. From this time he returned to his study of the development of the larval forms of these low organisms, especially with reference to *Comatula* and *Pentacrinus*, no doubt with the hope of arriving at some general conclusions as to the relations of their peculiar mode of development with that of the higher animals, and of showing their connection with extinct forms.

Mr J. V. Thomson had found his *Pentacrinus Europæus* in the Bay of Cork in 1823, and was thus the first to discover a recent

encrinite in the seas of Europe, as he was the first who ever had the opportunity of examining one in its living state. As the result he declared it to be the young of Comatula, and, comparing his youngest Comatula with the oldest Pentacrinus he could find, he demonstrated this relation to the satisfaction of Professor Edward Forbes, Dr Ball of Dublin, and the late William Thompson of Belfast. Yet much remained to be done to clear up the whole history of this single form, and this occupied Wyville Thomson for several years. A sketch of his "On the Embryogeny of *Comatula rosacea*" appeared in the *Proceedings of the Royal Society* for 1858, a paper "On the Embryology of *Asteracanthion violaceus*" was published in the *Microscopical Society's Journal* for 1861-62, and his paper "On the Pentacrinoid Stages of Comatula" was sent to the Royal Society in December 1862, read in February 1863, and published in the *Philosophical Transactions* for 1865. This paper is a model of care and accuracy, illustrated by many beautiful and highly artistic drawings of the various stages, executed by the author, and itself attests his powers of research and his accuracy of discrimination and delineation. Whilst engaged in this work, Thomson accumulated a large amount of material, with a view to give an account of the whole genus Pentacrinus at some future time. Indeed, as far as these researches on development are concerned, it is almost to be regretted that they so soon led to the great work of deep sea research, which, when once entered upon, took up so large an amount of time.

In a correspondence with Michael Sars, the celebrated Professor of Zoology in the University of Christiania, Wyville Thomson learned that the professor's son, M. Oscar Sars, whilst engaged, as one of the acting Commissioners of Fisheries, in a series of investigations as to the fisheries off the Loffoten Islands, north-west of the coast of Norway, had dredged up from about 300 fathoms a number of living animal forms. In response to an invitation from Professor Sars, Thomson visited Norway to examine these objects, and he states that amongst them there was a small erinoid of surpassing interest, which they at once recognised as a degraded type of the Apiocrinidæ, an order which had up to that time been regarded as entirely extinct. Some years previously M. Absjörnsen, dredging in 200 fathoms in the Hardangerfjord, procured several

examples of a starfish "Brisinga," which seems to find its nearest ally in the fossil genus Protaster. In this way it had become certain that animal life does not cease in the ocean at a depth of a few hundred fathoms, as the late Edward Forbes had supposed. Wyville Thomson tells us that, long previously to 1868, he "had a profound conviction that the land of promise for the naturalist, the only remaining region where there were endless novelties of extraordinary interest ready to the hand which had the means of gathering them, was the bottom of the deep sea." And when, in his visit to Norway, he became fully acquainted with the advantages which Professor Sars and his son had enjoyed through the means of their Government, he resolved to lose no opportunity of pointing out how greatly the Government of the most powerful maritime nation in the world might aid science by placing at the disposal of naturalists one of their numerous unemployed vessels to assist in the exploration of the ocean depths. A favourable opportunity presented itself when engaged with Dr W. B. Carpenter in working out the structure and development of the Crinoids in the spring of 1868. Dr Carpenter was a vice-president of the Royal Society, through which body alone it seemed that the Government could be influenced. He considered the subject carefully, and having arrived at a conclusion favourable to the project, it was resolved that he should bring the subject under the notice of the Society, introducing it by a letter which his colleague was to write to him after his return to London. The Royal Society and the Government entered heartily into the plan, and the dredging cruises of H.M.S. "Lightning" and "Porcupine" and the expedition of the "Challenger" were the result.

It has been already stated that Wyville Thomson was appointed to the chair of Mineralogy and Geology in Queen's College, Belfast, in 1854. On the removal of Dr Dickie to Aberdeen in 1860, the duties of the chair of Botany and Zoology were also entrusted to him, and he became from that time Professor of Natural History in these four branches. For the discharge of these duties he was very peculiarly fitted from the happy way in which he had at different times been called upon to teach the four subjects in succession. He had now the entire responsibility of the department of Natural History. In the year 1860 he was admitted to the degree of LL.D.

in the Queen's University *ad eundem*. As a resident in Belfast he entered heartily into every plan for the spread of knowledge or the improvement of his townsmen. He was an active member of the Natural History and Philosophical Society, and at its meetings he contributed many valuable papers. As a lecturer he was fluent in style, easy in manner, and lucid in thought and expression. He conveyed to his hearers much of the interest he had in his subject, and encouraged them to engage in original work. He was instrumental in placing the School of Science and Art in its present relation to South Kensington, and took a constant and lively interest in its success.

He was an active member of the local committee in connection with the meeting of the Social Science Congress in Belfast, under the presidency of the Earl of Dufferin, in 1867.

Interested in education, and attached to the system on which the Queen's Colleges and Queen's University were founded, he strenuously opposed all attempts to interfere with their academic character or their privileges. When a supplemental charter was issued, which it was believed would lessen the necessity for thorough academic training to obtain degrees in the Queen's University, Wyville Thomson came forward very prominently, and succeeded in collecting large funds, and obtaining still further guarantees from an influential committee, which enabled the validity of the charter to be tested in the Court of Queen's Bench. The result was that, after long and protracted arguments, an injunction was granted in 1867 by the Master of the Rolls which rendered the supplemental charter inoperative, and helped to prevent for many years the substitution of a system of mere examinations for the most complete academic training which prevailed in any university.

Regardless of the differences of religious and political opinion which prevailed in Belfast, he was courteous to all, tolerant of every opinion frankly formed, and never obtrusive of his own. He was esteemed by all classes and parties, he had friends everywhere, and his house was always open to all of distinction in science or art who might happen to visit Belfast. Engrossed in his own proper studies, he never obtruded them upon others, but whenever assistance or advice in connection with them were needed, he spared no pains to make both effective. His tact,

consideration, and good taste never failed him. His passion for flowers seemed a part of his nature; he cultivated them with the greatest care, and, though delighting to display them to the greatest advantage in his own house, he enjoyed equally his regular practice of carrying any particularly choice specimen he might have grown to present it to some of his many friends.

In 1867 he was made Vice-President of the Jury on Raw Products at the Paris Exhibition.

On the 30th May 1868 he addressed the letter to Dr Carpenter which was previously agreed upon, pointing out that Edward Forbes's conclusion, that a zero of animal life was reached at a depth of a few hundred fathoms, was incorrect, as had been proved by M. Absjörnsen's dredging starfishes at 200 fathoms, and by M. Oscar Sars dredging living crinoids from 300 fathoms; that the effect of pressure has probably been greatly exaggerated, because an equal pressure within and without by water would probably produce no injurious effect on animal life, and might even contribute to increase the aëration of the water; and that, looking at the condition of the cave fauna, it is probable that the diminution of light at great depths may only affect the development of colour and of the organs of sight. He suggested that, whilst dredging at 1000 fathoms was quite beyond the reach of private enterprise, it was quite practicable if the Admiralty could be induced to grant the use of a vessel for the purpose. He proposed to start from Aberdeen, to go first to the Rockall fishing banks, and thence north-westward towards the coast of Greenland, rather to the north of Cape Farewell.

Dr Carpenter wrote to General Sabine enclosing Professor Wyville Thomson's letter, pointing out the admirable results obtained by M. Sars, with similar aid granted by the Swedish Government; and showing that he and Dr Thomson had restricted their request within such conditions as could, without great expense or inconvenience, be acceded to by the Admiralty. On the evening of the day on which Dr Carpenter's letter was written, General Sabine brought the subject under the consideration of the council of the Royal Society, who at once approved of the proposal, recommended it to the favourable consideration of the authorities of the Admiralty, and advanced a sum of £100 to meet expenses. The

Lords Commissioners of the Admiralty wrote on the 14th July that they had given orders for Her Majesty's steam vessel "Lightning" to be prepared immediately at Pembroke to meet the wishes of the Royal Society. The "Lightning" left Pembroke on the 4th August 1868. Drs Carpenter and Thomson, and Dr Carpenter's son Herbert, joined the vessel at Oban, whence they sailed on the 8th August. They reached Stornoway on the 9th, and left it for the north on the 11th. On the same afternoon they dredged in 60 to 100 fathoms; on the 13th in 450 fathoms, finding no bottom, but the high temperature of 9.5° C.; afterwards in 600 to 700 fathoms in the same locality. Bad weather frequently impeded the dredging operations. On the return of the vessel to Stornoway on the 9th September, Dr Wyville Thomson was obliged to leave her to attend to duties in Dublin, but Dr Carpenter remained with the vessel, left Stornoway again on the 14th September and dredged in 650 fathoms, but on the 21st the weather was so bad that the work had to be concluded. There were only ten days available for dredging in the whole six weeks, and on only four of these was the vessel in water over 500 fathoms deep. Yet a fair measure of success had been achieved.

It was shown that varied and abundant animal life, represented by all the invertebrate groups, occurs at depths in the ocean down to 650 fathoms at least; and that, instead of deep sea water having an invariable temperature of 4° C., great masses of water, at temperatures varying from 2° C. to 6.5° C., maintain a remarkable system of oceanic circulation, and yet keep so distinct from each other that both may be found within the limit of an hour's sail. It was also ascertained that a large proportion of the forms living at great depths of the sea are of unknown species, and identical with tertiary fossils previously believed to be extinct.

The next year, 1869, saw Wyville Thomson again engaged in the examination of the physical, chemical, and biological conditions of the ocean depths, for the Lords Commissioners of the Admiralty had acceded to the additional request of the council of the Royal Society and had set apart the "Porcupine," a small vessel fitted up for surveying purposes and admirably adapted for the continuance of these researches, from the beginning of May to the middle of September. As it was impossible for those connected with the

previous expeditions to be absent from their public duties for any large portion of this time, it was resolved that there should be three separate cruises, one on the west coast of Ireland, the Porcupine Bank, and the channel between Rockall and the coast of Scotland, under the scientific charge of Mr Gwyn Jeffries, F.R.S.; a second to the north of Rockall, leading northwards to the point where the expedition of 1868 left off, under the charge of Dr Thomson; and the third to work over the "Lightning Channel" and check the former observations, under the direction of Dr Carpenter.

Mr Gwyn Jeffries was favoured with remarkably fine weather, and found it possible to dredge during seven days at depths greater than 1200 fathoms, and on four days at less depths. His deepest dredging was 1476 fathoms, and the whole of them yielded an abundance of novel and interesting results in every invertebrate sub-kingdom.

Captain Calver was accustomed to minute accuracy in surveying, and thoroughly versed in the use of instruments and in the bearings of scientific investigation. His crew were chiefly known and tried men, Shetlanders who had spent many successive summers in the "Porcupine" under his command. Aided by a staff of zealous officers, Captain Calver soon obtained so entire a mastery over the operation of dredging that he made it almost a certainty at depths at which this kind of exploration would have been previously deemed out of the question. Wyville Thomson at once recognised these favourable conditions, and having found that the experiences of the previous year, and all their anticipations for the present, had been realised, at least for the depth of nearly 1500 fathoms, and that even at that depth nearly all the types of living marine invertebrata were represented, though the number of species seemed reduced and the size of the animals dwarfed, he suggested that it would be desirable that the second cruise should be made in deeper water than had originally been intended, and pointed out the position of the deepest water easily accessible, 250 miles west of Ushant, as a fitting place for the next observations.

The Hydrographer cordially acquiesced in this proposed change of plan, and it was arranged that the next dredging should be done at this spot, in water 2500 fathoms deep. Professor Wyville

Thomson left Belfast in the "Porcupine" to take the scientific direction of this cruise on the 17th July 1869, taking with him Mr Hunter, F.C.S., chemical assistant in Queen's College, Belfast, to examine and analyse the samples of sea water. At Queenstown Mr P. Herbert Carpenter joined the ship to practise the gas analysis which he was to undertake on the third cruise.

The vessel proceeded on her voyage at 7 P.M. on the 19th July, steaming in a south-westerly direction across the mouth of the channel. At 4.30 A.M. on the 21st they were still only on the plateau of the channel in 95 fathoms of water, but from midday to the afternoon they passed over the edge of the plateau and dredged in 725 fathoms, the bathymetrical horizon of vitreous sponges in the northern seas, bringing up several specimens of these beautiful forms, and a slight admixture of globigerina ooze in sand. On the 22nd they were in water of about the greatest depth they had reason to expect, 2435 fathoms, at a temperature of 2.5° C. A successful dredging yielded 1½ cwt. of grey chalk mud, containing examples of each of the invertebrate sub-kingdoms, which, though dead, had evidently been alive when they entered the dredge. Similar results attended a dredging on the 23rd at the same depth, after which the party returned to the coast of Ireland, dredging and noting the results at intervals on the way. The vessel reached Cork on the 2nd August, and Belfast on the 4th.

She left again on the third cruise for the year, on the 11th August, under the direction of Dr Carpenter, Mr P. H. Carpenter undertaking the analyses, and Wyville Thomson accompanying them. He busied himself in drawing, naming, and describing new species, and in noting the great general features of the prevailing physical and vital conditions. It is scarcely possible for anyone, however little imaginative, to read the graphic accounts of the incidents of these voyages without having his enthusiasm aroused, and almost wishing to have been present on many of the occasions so forcibly depicted. It seems more like a dream than a reality that at a single haul the dredge should have brought up in its bag and on its tangles not less than 20,000 specimens of the pretty little urchin, *Echinus norvegicus*, and we have Dr Thomson's authority for such an event having happened. On other occasions, one is irresistibly brought to watch, with bated

breath, the landing of the great prizes which the dredge had collected. His account of the glimpses from time to time as the dredge was coming in, of what seemed to be a large scarlet urchin, the disappearance of it now and then as if lost altogether, then its quiet settling down as a round red cake, and beginning to pant,—that he had to summon up some resolution before taking the weird little monster in his hand,—show the graphic power of the author no less than the enthusiasm of the naturalist.

I cannot forbear giving another illustration:—"I do not believe human dredger ever got such a haul. The special inhabitants of that particular region—vitreous sponges and echinoderms—had taken quite kindly to the tangles, warping themselves into them, and sticking through them and over them, till the mass was such that we could scarcely get it on board. Dozens of great *Holtenia*, like

Wrinkled head and aged,
With silver beard and hair ;'

a dozen of the best of them breaking off just at that critical point where everything doubles its weight by being lifted out of the water, and sinking slowly away back again to our inexpressible anguish ; glossy whisps of *Hyalonema* spicules ; a bushel of the pretty little mushroom-like *Tisiphonia* ; a fiery constellation of the scarlet *Astropecten tenuispinus* ; while a whole tangle was ensanguined by the 'disjecta membra' of a splendid *Brisinga*."

The effect of the brilliant phosphorescence of the contents of the dredge are vividly pourtrayed ; and the argument in favour of the urchins, which are only one-fourth of the size of others whose characters are indistinguishable from theirs, being dwarfed specimens of the same genus, is not easily forgotten:—"The Shetland variety of *Equus caballus* is certainly not more than one-fourth the size of an ordinary London dray-horse, and I do not know that there is any good reason why there should not be a pony form of an urchin as well as of a horse."

Wyville Thomson had arranged with his colleagues to take part in an exploration of the deep sea to the south of Europe and the Mediterranean in 1870, but he was prevented from doing so by an attack of fever. Yet he gave at second hand a brief account of the

first part of the work under the direction of Mr Gwyn Jeffries to complete his sketch of the condition and fauna of the North Atlantic ; and directed attention to the entirely exceptional conditions of temperature and animal life observed by Dr Carpenter in the Mediterranean as compared with the outer ocean.

In the whole life of Thomson, notwithstanding his vivid appreciation and accurate descriptions of the most minute details of structure necessary for the determination of new species, and for allotting them their proper position in nature, he never allowed himself to be dragged down to the level of a mere collector, accumulating myriads of individual objects and cataloguing them. He invariably rose superior to details, and, subordinating them as merely means for arriving at just conclusions regarding the physical and vital characters of the earth and its living freight in long past ages or the present time, he devoted his best thoughts to the consideration of the means by which great results might be achieved. The idea that either individual or even imperial aid was necessary neither occasioned him anxiety nor discouraged him ; he resolutely set forth the conditions, showed how important results could be arrived at, and the means never failed him.

His discussion of the effects of the Gulf Stream on the climate of the coasts of Northern Europe, in comparison with the influence of any possible general ocean circulation, is a good illustration of his wide and powerful grasp of natural phenomena bearing on any particular point. He had measured in the North Atlantic the extent of the warm and cold areas of water, and recognised the fauna which are proper to each ; he had determined the existence of the vast layer of cold water, 1500 fathoms thick, at the bottom of the Bay of Biscay, and that the temperature there at 1230 fathoms from the surface is the same as that of the bottom off Rockall ; he saw that, whilst the communication of the North Atlantic and the Arctic Sea is restricted, the communication with the Antarctic basin is, as he describes it "open as the day,"—a continuous and wide valley, upwards of 2000 fathoms in depth, stretching northwards along the western coasts of Africa and Europe ; and then pointed out how much less startling than it appears at first sight is the suggestion that the cold water filling deep ocean valleys in the northern hemisphere may be partly derived from the southern. He calls to mind

that the floor of the Atlantic is covered by a creamy, flocculent layer of microscopic animals; whilst, wherever there is any known current, this deposit is absent and replaced by gravel, and thus shows that the movement of any cold indraught of water at the bottom must be excessively slow. He dispels the chimerical idea that there is a kind of equatorial diaphragm between the northern and southern ocean basins, and explains that it is only on the surface of the sea that a line is drawn between the two hemispheres by the equatorial current. He then gives as evidence of the slow indraught of cold water from the Southern Sea, that it is colder than the mean winter temperature of the area which it occupies and that of the crust of the earth, and that its temperature rises as it is traced northward; whilst, owing to Behring's Straits being only 40 fathoms deep, there is no adequate northern source of such a body of cold water.

In 1869 Wyville Thomson was elected a Fellow of the Royal Society; and in the year following, on the resignation of Dr Allman, he was appointed Professor of Natural History in the University of Edinburgh. His friends in Belfast recognised the distinction which had thus been conferred upon him, but felt the loss which the college and the town had sustained by his removal, and, on taking leave of him, presented him with a handsome service of plate and an illuminated address at a public meeting presided over by the mayor. The honorary degree of D.Sc. was conferred upon him by the Queen's University about the same time.

His duties now became more arduous than ever. His class-room was crowded with students, whom he taught not merely by lectures but by practical demonstrations. In 1871, the meeting of the British Association in Edinburgh, the arrangement and plans of the new University buildings, troubles in connection with the admission of females to the college classes, and the transfer of the Museum of which he was Regius Keeper, to the Museum of Science and Art, added greatly to his necessary labours.

At this time the rapid extension of ocean telegraphy gave practical value to everything which concerned the depth of the ocean, the character of its bottom, and the presence there of animals which might injure the coverings of telegraphic cables, whilst great interest was being manifested by the public in the remarkably novel experiences of the cruises of the "Lightning" and the "Porcupine."

From America and from Europe more or less effective expeditions had been sent out, but it was evident that it rested very specially with England to lay down the first broad outlines of the physical and biological conditions of the bottom of the ocean.

The circumstances were very propitious; and when Dr Carpenter addressed a letter to the First Lord of the Admiralty, urging the despatch of a circumnavigating expedition for this purpose, their lordships, after a favourable report of the Hydrographer to the Navy, agreed to despatch such an expedition, if the Royal Society recommended it and furnished them with a feasible scheme.

Mr Lowe, then Chancellor of the Exchequer, with great interest and sagacity, saw that such an enterprise was entirely beyond the reach of private means, and agreed to furnish the necessary funds. The "Challenger" was chosen for the purpose, with Captain Nares, a surveying officer of great experience and skill, to command her, and Professor Wyville Thomson as director of the Civilian Scientific Staff. He tells us that "when the suggestion was made to him at the commencement of the negotiations to join the expedition, the sacrifice appeared in every way too great; but as the various arrangements progressed, so many friendly plans were proposed on all hands to smooth away every difficulty, that he finally accepted a post which, to a younger naturalist, without the ties of a family and a responsible home, would be perhaps among the most delightful the world could offer."

The President and Council of the Royal Society nominated the members of the Civilian Scientific Staff, and a Circumnavigating Committee, amongst whom were Dr Carpenter and Dr Wyville Thomson, suggested a scheme whereby it was believed the best results might be obtained. Sixteen of the eighteen large guns which the "Challenger" carried were removed; she was fitted with a natural history workroom, a chemical laboratory, and furnished with every scientific appliance to the satisfaction of the director, and in a way entirely unprecedented for scientific purposes. With a ship thus equipped, and the responsibility of directing the most delicate and difficult scientific observations at sea for a period of three or four years, Dr Wyville Thomson left Portsmouth on the 21st December 1872 with the good wishes and ardently expressed hopes of every lover of science in Great Britain.

The first part of the voyage, that to the Canary Islands, was made merely tentative, with a view of getting everything on board into perfect order for correct observations, and dividing the labour of research in the most convenient way amongst the members of the staff.

On the 14th February 1873 the "Challenger" sailed from Santa Cruz to cross the Atlantic, and the real work of the expedition commenced. She reached Sombrero on the 15th March, the Bermudas on the 4th April, and Halifax on the 9th of May. Leaving Halifax again on the 15th, she went southwards and back to the Bermudas, to make another section of the Gulf Stream. On both occasions the most detailed and interesting observations were made. Subsequently she crossed the Atlantic three times, visited Australia, New Zealand, the Malay Archipelago, Hong Kong, and Valparaiso, sailing altogether 68,930 miles, and returning to Sheerness on the 24th May 1876, after an absence of three years and a half.

Shortly after his return, Dr C. Wyville Thomson received the honour of knighthood, and was appointed by the Lords Commissioners of Her Majesty's Treasury "Director of the 'Challenger' Expedition Commission." In the same year he was awarded a Royal Medal by the Royal Society for his successful direction of the scientific investigations carried on by H.M.S. "Challenger."

In July he and the other members of the scientific staff of the "Challenger" were entertained at a banquet in Edinburgh. On going with Emeritus Professor Balfour to Upsala, as the representative of the Senatus of the University of Edinburgh on the occasion of the tercentenary of that ancient University, the King of Sweden created him a Knight of the Order of the Polar Star. He was a Fellow of the Royal Societies of London and Edinburgh, a Fellow of the Royal Irish Academy, Ph.D. Jena, Fellow of the Linnean, Geological, Zoological, and Palæontological Societies of London, and of various foreign and colonial institutes. In 1877 he was appointed to deliver the Rede Lecture at Cambridge, and in 1878 he presided over the Geographical Section of the British Association at its meeting in Dublin, and was made LL.D. of the University of Dublin.

Sir Charles discharged the duties of his chair with his customary vigour on his return from the voyage of the "Challenger," and

worked laboriously at the vast amount of material and observations which had been accumulated. In 1877 he published two volumes of a preliminary account of the results of the voyage, a work of surpassing interest, not alone from the scientific value of the observations recorded in it, and the conclusions which the author draws from them, but for the beautifully executed illustrations it contains, and the graphic sketches which occur here and there of the general as well as the scientific features of the places visited and examined. In this work Sir Charles has recognised the valuable assistance of his colleagues in the scientific staff; the aid which all the naval officers, without exception, gave in the most friendly spirit to the civilian staff; the wonderful temper with which the commander and first lieutenant tolerated all the irregularities inseparable from dredging and other scientific work; the friendly readiness with which the chief of the naval scientific staff placed his valuable observations at the disposal of the civilian staff; the patience and care displayed by the lieutenants who superintended the dredging and trawling and the estimations of temperature; and his debt of gratitude to the sailors for the respect and consideration with which they treated all the civilians on board.

These were, no doubt, remarkable results—this combination of everyone on board to achieve success, this subordination of the discipline, cleanliness, and order of a man-of-war to the prosecution of the study of Natural Science in various departments; and it cannot be doubted that they were mainly due to the genial disposition, the many engaging social qualities, the gentlemanly bearing, and the untiring energy of Sir Charles Wyville Thomson.

He admitted that the strain, both mental and physical, was long and severe, and that it had told upon all of them. His friends observed that, with the continuance of the labours necessary for bringing out the full account of the whole results of the "Challenger" Expedition, his vigour by no means kept pace, but until 1879 there was no real cause for anxiety. In June of that year, however, he had a serious illness, from which he only partially recovered. His place in the University of Edinburgh had to be supplied, and at length arrangements were made for securing to him a well-deserved retiring allowance. From time to time he persevered in endeavouring to forward the publication of the com-

plete reports of the Expedition, and still attended meetings of the Commissioners of Supply for his native county. He even sat as magistrate sixteen days before his fatal illness. But from his first seizure he was unable to discharge the duties of his chair, and retired from them altogether in the October of 1881. Subsequently he had also to relinquish his position as "Director of the 'Challenger' Expedition Commission." In the beginning of March 1882 his critical condition was manifested by his making a personal application to be relieved from attending at the Fiars' Court on the 10th of that month, the very day on which his last seizure proved fatal. He died at the early age of fifty-two, having made many lasting contributions to science, secured large numbers of sincere admirers and friends, and received the applause and approval of scientific men everywhere for the wisdom, energy, skill, and courtesy which he had shown in the direction of the most extended and successful of scientific expeditions.

Lady Wyville Thomson survives her husband. He left an only child—Mr Frank Thomson, M.A. Ed., a student of medicine.

The Commissioners of Supply of the county of Linlithgow, with a committee of scientific and other friends in Edinburgh, have collected several hundred pounds for the purpose of erecting a lasting memorial to commemorate the distinguished services of the late Sir Charles Wyville Thomson, and it has been resolved to place a bust by Hutchison in the University of Edinburgh, and a memorial window in the beautiful collegiate church in his native place.

The following is a list of Sir C. Wyville Thomson's principal publications :—

On the Application of Photography to the Compound Microscope. *Brit. Assoc. Rep.*, part 2, 1850.

Notes on some Scotch Zoophytes and Polyzoa. *Annals Nat. Hist.*, ix., 1852.

On the Character of the Sertularian Zoophytes. *Brit. Assoc. Rep.*, part 2, 1852.

Notes on some British Zoophytes. *Annals Nat. Hist.*, xi., 1853.

On Native Irish Zoophytes and their Allies. *Nat. Hist. Rev.*, ii., 1855.

On the Embryogeny of *Comatula rosacea*, Lutk. *Roy. Soc. Proc.*, ix., 1857-59.

On some Species of Acidaspis from Silurian Beds of South of Scotland. *Geol. Jour.*, 1857.

Description of *Loricula macadami*, a new fossil Cirripede. *Ann. and Mag.*, 1858,

On New Genera and Species of Polyzoa from the collection of Professor Harvey, Dublin. *Nat. Hist. Rev.*, July 1858.

On a New Palæozoic Group of the Echinodermata. *Edin. New Phil. Jour.*, xiii., 1861.

On the Embryology of *Asteracanthion violaceus*, Lin. *Mic. Soc. Jour.*, i., 1861-62.

On the Development of *Synapta inhærens*. *Mic. Soc. Jour.*, ii., 1862.

On Distorted Human Skulls. *Nat. Hist. Rev.*, 1862.

On the Embryology of Echinodermata. *Nat. Hist. Rev.*, 1863, 1864.

On the Embryogeny of *Antedon rosaceus*, Linch (*Comatula rosaceus* of Lamarck). *Phil. Trans.*, 1865.

On Professor Steenstrup's "Views on the Obliquity of Flounders." *Ann. Mag. Nat. Hist.*, 1865.

Sea Lilies (*Cenocrinus*—*Neocrinus*—*Comatula*). *Intellect. Obs.*, vi., 1865.

On the Glass Rope (*Hyalonema*). *Intellect. Obs.*, xi., 1867.

On the Vitreous Sponges. *Ann. Mag. Nat. Hist.*, 1868.

On *Holtenia*, a Genus of Vitreous Sponges. *Phil. Trans.*, clix., 1869.

Geological Dynamics. *Glas. Geol. Soc.*, 1869.

On the Depths of the Sea. *Roy. Dublin Soc. Jour.*, v., 1870.

Osteology of *Polypterus*. *Jour. Anat.*, 1870.

On Deep-Sea Climates. *Nature*, ii., 1870.

Preliminary Report in connection with Drs W. B. Carpenter and J. G. Jeffries of the Scientific Exploration of the Deep Sea in H.M.S. "Porcupine." *Roy. Soc. Proc.*, xviii., 1870.

On the Distribution of Temperature in the North Atlantic. *Nature*, iv., 1871.

On the Continuity of the Chalk. *Nature*, iii., 1871.

On the Structure of the Palæozoic Crinoids. *Edin. Roy. Soc. Proc.*, vii., 1871.

Notice of a New Family (Echinothuridæ) of the Echinodermata. *Edin. Roy. Soc. Proc.*, vii., 1872.

Deep Sea Echinidea. *Ann. Mag. Nat. Hist.*, 1872.

On the Crinoids of the "Porcupine" Deep-Sea Dredging Expedition. *Edin. Roy. Soc. Proc.*, vii., 1872.

Opening Address on the Ripening and Decay of Fruit. *Edin. Bot. Soc. Trans.*, 1873.

On the Echinoidea of the "Porcupine" Deep-Sea Dredging Expeditions. *Phil. Trans.* 1874; *Proc. Roy. Soc.*, 1872.

The Depths of the Sea. (1 vol.), 1873.

On Dredgings and Deep-Sea Soundings in the South Atlantic, in a letter to Admiral Richards, C.B., F.R.S. *Roy. Soc. Proc.*, 1874.

Preliminary Notes on the Nature of the Sea-bottom, procured by the Soundings of H.M.S. "Challenger" during her Cruise in the Southern Sea in 1874. *Roy. Soc. Proc.*, 1874.

Report to the Admiralty on the Cruise of H.M.S. "Challenger" from July to November 1874. *Roy. Soc. Proc.*, 1875.

Notice of New Living Crinoids belonging to the Apiocrinidæ. *Linn. Soc. Jour.*, "Zoology," vol. xiii.

Report to the Admiralty on the Cruise of H.M.S. "Challenger" from June to August 1875. *Roy. Soc. Proc.*, 1875.

Some Peculiarities in the Mode of Propagation of certain Echinoderms of the Southern Sea. *Linn. Soc. Jour.*, "Zoology," vol. xiii., 1878.

Preliminary Report to Admiralty on the Cruise of the "Challenger" between Hawaii and Valparaiso. *Proc. Roy. Soc.*, 1876.

Preliminary Report to Admiralty on the Cruise of the "Challenger" from Falkland Island to Monte Video. *Proc. Roy. Soc.*, 1876.

On the Structure and Relations of the Genus *Holopus*. *Edin. Roy. Soc. Proc.*, 1877.

Voyage of the "Challenger. The Atlantic. (2 vols.), 1877.

On the Conditions of the Antarctic Regions. *Glas. Science Lectures' Assoc.*, 1877.

Presidential Address to the Geographical Section. *Brit. Assoc.*, *Dublin*, 1878.

The General Introduction to the Zoological Series of the Reports of the Voyage of the "Challenger." Vol. i, "Zool.," 1880.

Note.—Sir Charles Wyville Thomson had also undertaken to write the "Report on the Crinoidea" of the voyage of the "Challenger" in conjunction with Dr P. H. Carpenter.

MR THOMAS WILLIAM RUMBLE. By William Connor Steel
Rumble.

MR THOMAS WILLIAM RUMBLE was born in London, 26th December 1832. He received part of his education at the Reading Grammar School, under the celebrated Dr Valpy. At an early age he was transferred to the office of his father, an architect in good practice, where he was taught the rudiments of his future profession. Tiring of the dull routine of the drawing-office, he left home to try his fortune across the Atlantic, where, after many adventures, he was appointed in November 1850 assistant engineer on the Central Railroad of New Jersey, under J. Laurie, Esq., C.E., he being then not quite 18 years of age. He remained in America till June 1852, during which time he was actively engaged in laying out the Erie and Forest Lawn Cemeteries, superintending the building of the Berks County Baths, the Buffalo Public Wash-houses, &c., and occasionally giving lectures on architectural and engineering subjects. Dr Calvin Fairbanks, in a letter dated 1st October 1851, speaks thus of his ability as a lecturer:—"I must say I was gratified with the clearness with which you presented the necessity of developing the yet undeveloped facts in architecture, in your last evening's lecture. It would have been happy had there been a more general interest at an earlier period. I hope, Sir, it may be convenient for you to favour us again with a repetition of the same, followed by illustrations and remarks."

Almost immediately on his return to England, Mr Rumble obtained work in Kensington, superintending the building of All Saints' Church and the laying out of the Kensington Park Estate.

In October 1853 he went out to Bombay, as assistant engineer on the Bombay, Baroda, and Central India Railway, then in course of construction. An attack of fever obliged him to return on sick