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Makers of Science

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fully recognized by the average community, it will be comparatively easy to sell the people the enlarged programs of science offerings that most of us would like to see in our high schools. Not only for biology specifically, but for many other sciences, we might agree with Dr. Lynda Webber, who is quoted in School Science and Mathematics for May, 1930, as saying, "I am of the opinion that it would be a good thing to require biology as one of the basic sciences in our high schools, *provided* the *social aspects* of it are emphasizzed." C. L. Jackson.

MAKERS OF SCIENCE

In the November number of the **Science Bulletin** the suggestion was made with reference to science clubs that "Human interest biographies of noted scientists" would be interesting and helpful. This idea has appealed to the writer as a sound one and has inspired the writing of the present article.

After a recent study of the history of the Smithsonian Institution at Washington and of the Royal Institution in London, we have selected the names of eight men noted in the development of physical science. Some questions are proposed and some facts quoted, all of which, it is hoped, may stimulate discussion and study.

What is the purpose of the Smithsonian Institution, and what Englishman is responsible for founding it, although he never visited America?

Who was the first secretary of this institution, and what electrical unit has been named for him?

What flying field was named in honor of a later secretary, who (it is said) died of a broken heart because of disappointment at the seeming failure of his most famous experiment?

What American-born scientist founded the Royal Institution, and what was his most notable achievement in the scientific world?

Finally, what other American lived in the same period as the one last referred to, was christened with the same name, gained great scientific recognition in Europe, and also founded a scientific society of note? In all probability these two men never met, though born in neighboring towns. The narrative which follows may answer some of these questions.

The story of James Smithson who bequeathed a considerable sum of money to the United States to set up an institution "for the increase and diffusion of knowledge among men" is an interesting one which may be found in the Encyclopedia Brittanica and also in the Smithsonian Report, Volume XXI (1879-80). There was some opposition to the acceptance of this money but finally in August 1846 Congress passed an act by which it was received and thus completed the founding of the institution.

The second question is largely answered by reference to the first article in the Science Bulletin of May, 1930. The controversy which arose over the invention of the electromagnetic telegraph calls attention to the valuable work of Joseph Henry, although the name of Samuel F. B. Morse is usually given as the inventor. This will furnish an additional topic for investigation. Another topic for further study is also suggested: what phenomena reported by Michael Faraday of the Royal Institution had already been observed by Joseph Henry in America?

Samuel P. Langley became secretary of the Smithsonian Institution in 1887. One of his inventions was the bolometer which is so delicate that it will indicate a change of temperature of one ten-millionth of a degree centrigrade. For many years he experimented with a flying machine which was based upon his observation and study of the flight of birds. The principle was in all probability correct but the gas or internal combustion engine had not yet been

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A NEW COLUMN

The suggestion has several times been made that a column be set apart in the Science Bulletin for the exchange of ideas by teachers in the field. The thought is that any specially valuable devices, interesting experiments, or successful projects will be reported there and so be made available to all the science teachers of the state. In conformity with this suggestion such a column will be placed at your disposal each of the remaining issues of the year.

Send to the editor descriptions of your favorite experiments or projects—new and better ways, for either the class room or the laboratory; new observations in nature study; anything that will help others to make work more interesting.

Such accounts should be in form for publication, typewritten, and expressed in the briefest compass consistent with the material reported. In general they should not exceed two hundred words. They should reach the editor at least ten days before the date of publication, which, for the next two issues, will be March tenth and April fifth respectively.

QUESTION BOX

Question:

Can two violins playing the same pitch simultaneously be heard farther than one?

Answer:

Yes, the two violins will combine to make a sound whose intensity will in general be twice as great as that of one. The two will therefore be heard about forty percent farther. If one violin could make as loud a sound as two there would be no need of the multiplication of instruments of the same kind in an orchestra. One of a kind would be sufficient.

Destructive interference cannot be maintained between sounds from two distinct sources.

MAKERS OF SCIENCE

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perfected and his scheme of propelling the machine was insufficient. This proved a great disappointment. By the irony of fate, it must be recorded that after Langley's death a compact gas engine was installed and his machine was made to fly. The correctness of his theory was therefore demonstrated.

The story of the founding of the Royal Institution in London is in striking contrast to that of the Smithsonian Institution. During the eighteenth century, though some years apart, two boys were born in territory which is now Greater Boston. Both boys were named Benjamin. One of them was renowned as a scientist and patriot. His face now appears upon a common postage stamp, his statue adorns the City Hall of the "City of Brotherly Love," and nearly every town of considerable size in the United States has a street named for him. He was also a statesman and served his country as an Ambassador to France during the trying times of the American Revolution.

The other Benjamin, Thompson by name, attended scientific lectures at Harvard College, taught school in New Hampshire, was misunderstood in the days of the American Revolution and finally fled from the country to reside in England. Later he went to Bavaria and served the Elector there in a military capacity. He gained great favor for his services and his scientific achievements. From his experience in

the boring of cannon he developed a new theory of the nature of heat, the one now universally accepted. When he was honored with the title of Count, Benjamin Thompson chose the name of the New Hampshire town where he had lived, **Rumford**, and we know him now as Count Rumford. It was he who founded the Royal Institution in London, 1799. For his success in reclaiming the land, and building the English Garden—a beautiful park in Munich—a statue to Rumford's memory was erected near the entrance to the garden. One of the streets of Munich bears the name of Rumford. He never returned to America though his thoughts must often have gone there. He established the Rumford professorship in Harvard and left an endowment for the Rumford prize in the Royal Institution. In later life he lived in France and married the widow of the ill-fated chemist Lavoisier. Upon his death in 1814, he left his books to the government of the United States and his gold watch to Sir Humphrey Davy, Professor of Chemistry and Director of the Royal Institution who will be mentioned later in this paper.

Doctor Thomas Young, an Englishman born in 1773, was a very precocious child, in fact an infant prodigy. At nineteen he began his medical education in London and continued his studies in Edinburgh, Göttingen, and Cambridge. His earliest research work was upon the optical properties of the eye and the subject of light in general. He espoused the neglected undulatory theory of light, the history of which suggests another topic for discussion. He became professor of natural philosophy in the Royal Institution in 1800, the year following its founding by Count Rumford. In 1801 he read a paper before the Royal Society (not to be confused with the Royal Institution) on the Principle of Interference of Light. His views were attacked by Lord Brougham in the Edinburgh Review. Professor John Tyndall refers to Young's experience in his Six Lectures on Light (delivered in America in 1872-1873) and states that Young's views were upheld by the two Frenchmen Fresnel and Arago. The names of Helmholtz and Maxwell should also be associated with that of Young in the history of the study of light.

In 1801, Sir Humphrey Davy, referred to above, took the position of lecturer in chemistry at the Royal Institution. Coleridge said of him, "I go to Davy's lectures to increase my stock of metaphors." Someone has remarked that Davy's greatest discovery was Michael Faraday. Faraday was born in 1791 in London, the son of a blacksmith. He received a very meager education. At thirteen years of age he was an errand boy at a bookstore and bookbindery, and later was apprenticed to the bookbinder. He liked to read scientific books which happened to pass through his hands. He sometimes attended lectures on natural philosophy, his brother paying the admission fee for him. In 1812 he fortunately heard four lectures at the Royal Institution by the great chemist, Sir Humphrey Davy. He wished, as he says, "to enter the service of science," and accordingly sent a letter to Sir Humphrey Davy enclosing the lecture notes which he had written and expressed a desire to continue his study of science. Davy replied to his letter and in 1813 installed Faraday as his assistant to wash bottles and help set up apparatus at the Royal Institution. Faraday soon began original researches. In 1816 he published his first paper and commenced his lectures before the "City Philosophical Society." In 1821 he married and brought his wife to his rooms in the institute where they lived together for forty-six years. He became director of the Royal Institution in 1825. Faraday has been called "the greatest experimentalist of the nineteenth century in the field of electricity and magnetism."

Professor John Tyndall writes of his work: "I can not help thinking that this discovery of magneto-electricity is the greatest experimental result ever obtained." We must remind the reader, however, that in the discovery of magneto-electricity the name of Faraday should be accompanied by that of Joseph Henry.

In 1837 Joseph Henry was in Great Britain and became personally acquainted with England's great physicists, Faraday, Wheatstone, and Daniell.

John Frederic Daniell invented his cell in 1836 which grew out of his contact with Faraday and which he described in a letter to Faraday. In the original cell the concentrated copper sulphate solution and dilute sulphuric acid were separated from each other by an animal membrane—the windpipe of an ox.

Reference has already been made to Benjamin Franklin. He founded in Philadelphia the American Philosophical Society, which has continued until the present time. Although Franklin never met Count Rumford either in America or in France, he had acquaintance with Madame Lavoisier (while her first husband was still living) as is shown in Sparks' Franklin, Volume X, pages 361-2, as quoted in the Life of Count Rumford by George E. Ellis.

The final scientist in this group is Professor John Tyndall who was born in Ireland in 1820 and lived in England after his twenty-first year. At one time he studied chemistry under Bunsen. After a year in Berlin he delivered a lecture at the Royal Institution in 1853, concerning which it is stated that "it took his audience by storm." He was elected professor of natural philosophy in the institution and there he carried on his researches which were in the domain of heat. "He possessed extraordinary powers of popularizing difficult subjects, especially through his books, such as **Heat as a Mode of Motion.**"

In concluding this short and imperfect sketch of the lives and work of Count Rumford, Benjamin Franklin, Joseph Henry, Michael Faraday, Samuel Langley, Thomas Young, Sir Humphrey Davy, and John Tyndall, our labor will be lost if it does not suggest a few points of interest for classes or science clubs. What may be done in physical science may be repeated in any of the other sciences by a study of the publications of the Smithsonian Institution.

The following works have furnished most of the foregoing information: **Encyclopedia Brittanica, Publications of the Smithsonian Institution, Cajori's History of Physics.** S. F. Hersey.

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HUMAN Physiology

As a small boy I recall sitting near the front of the room in a rural school with my legs swinging vigorously several inches from the floor, and listening while a large group of older boys and girls attempted to recite the names of the bones of the body as well as many other parts. The class appealed to me principally because it seemed to give great pain to the participants, and because it was still a long way off so far as I was concerned. With much less glee do I recall the time a few years later when I was promoted to the class in which I also was supposed to learn physiology.

In retrospect I can perceive that physiology was probably the correct term, because by no stretch of the imagination could it be called human physiology inasmuch as it was lacking entirely in the human element. We would have welcomed an opportunity to learn something about ourselves—what made the wheels go around inside us, or whatever it was that happened, but nothing like that was suggested. We began by learning the names of the bones. We had no conception of what they really looked like or how they were put together. The rest of the course was much the same. Not once was there a comparison of the subject matter with our own bodies.