THE CHEMICAL LABORATORY. SIDE LIGHTS IN ITS MAKING.*

BY FREDERIC E. NIECE.

Prior to the present conflict, there hung in the Louvre at Paris an interesting picture, depicting in a most realistic fashion an alchemist at work in his sixteenth century laboratory.

The painting portrays a low, dingy basement, showing furnaces arranged here and there, which have in later years been transformed into our modern vapor chambers.

On the floor, scattered about this aged creature, may be seen many crude looking implements of the time. Closer observation reveals some worn-out alembics, charred and time-worn crucibles, scarred and battered retorts, mortars, pestles, and whatnot. Suspended from the ceiling one may see huge specimens, representative of prehistoric times. Huddled about the strange, old, gray-haired figure is a group of intensely interested students. Their facial expressions and inclining attitude foretell amazement, as they watch each move the decrepit exponent of alchemy makes. Their attention seems to be completely absorbed as they appear to listen with the closest order to each word the old man utters in explanation of each step in the obscure process which, as they hope, will lead to the creation of the proverbial "philosopher's stone:" the "ancient stone" to which is alleged the ever ready power(?) to transmute the baser metals into gold—the noblest of all the noble metals.

It also appears that he is divulging to this select few, with the greatest minutia, the secret involved in the search for that "Priceless Elixir" with eternal virtues that are so conducive to that much envied desire of "long life."

The entire make-up of the picture is one of absorbing interest and seeming seclusion, for apparently there is no desire to publicity, as the old, bent-over creature, in his own manner goes on with his vivid portrayal as to how it shall all come to pass. But as centuries have come and gone we have earned to realize how vain have been his hopes but how fruitful have become his efforts.

Too true has this since become, for it was upon this very crumb of an ill-founded tradition and mistaken belief that the foundation of a most wonderful institution was first laid—an institution small and poorly conceived in its beginning, but large, spacious and indispensable in its completion.

Thus we can picture in our mind's eye, if we will, the inception and creation of our modern chemical and pharmaceutical laboratory, embodying as it were a series of trials and tribulations by reason of its associations with misguided theories—a struggle for existence in the face of a most fantastical opposition; and its triumph, because of its proven virtues in spite of the most adverse circumstances. In a measure the labors of these early workers were not entirely all in vain. No, for aside from their ignorance, superstition and lack of proper training, their reward has been great, for they gave the laboratory its impetus and to-day we find it a most powerful factor in both our scientific and commercial worlds.

The very thirst for knowledge by these poorly advised creatures was the making of all that the present-day laboratory implies.

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Many of the results, as we have studied them, from the dark ages up to and through more recent centuries, have changed but little, while years of toil may appear to have resulted in the waste of time, the loss of money and the sacrifice of patience, have, by persistency of purpose, turned impending failure into lasting success, notwithstanding the hardships attending the efforts.

How true this is can be no better realized than in the experiments of Archmedes over two centuries before Christ. His method of detecting metals by their specific gravities has not changed in principle, only in application. So we may gainsay, that these earlier workers and the workers of the middle ages left a soil so fertile that those who took up the tilling where they left off gave us as a result much good ground in which to develop our own abilities. By virtue of all this there was born out of it many whose lives have been guiding stars in the firmament of experimental research, an inestimable heritage of scientific wealth.

Take for instance the immortal Justus von Liebig; the great investigator, Davy; the ill-fated Lavoisier; Dalton, of atomic theory; Bunsen, Wöhler, of organic chemistry fame; Priestly, the discoverer of oxygen; Cavendish, of hydrogen; Ramsay, of metal transmutation fame; and the Curies, with their discoveries in radio-activity; Pasteur, Ehrlich and others,—all of these and many others were little thought of, much less their achievements, until their efforts were confirmed in the physical or chemical laboratory and the results thereto thoroughly established and thus given to the world. To the laboratory of whatever purpose, we owe much for that which it has done it has done well. It has been instrumental in not only revolutionizing industry but creating many new ones. It has caused a better people, a greater nation and a safer world.

Liebig, in addressing the British Association for the Advancement of Science, in 1852, said:

"One of the most remarkable features of modern times is the combination of large numbers of individuals representing the whole intelligence of nations, for the express purpose of advancing science by their united efforts of learning its progress, and of communicating new discoveries. The formation of such associations is of itself an evidence that they were needed. It is not everyone who is called by his situation in life to assist in extending the bounds of science; but all mankind have a claim to the blessings and benefits which accrue from its earliest cultivation. The foundation of scientific institutions is an acknowledgment of these benefits and this acknowledgment proceeding from whole nations may be considered as the triumph of mind over empiricism. Innumerable are the aids afforded to the means of life to manufacture and to commerce by the truths which assidious and active inquirers have discovered and rendered capable of practical application. But it is not the mere practical utility of these truths which is of importance. Their influence upon mental culture is most beneficial and the views acquired by the knowledge of them enable the mind to recognize in the phenomena of nature, proofs of an infinite wisdom for the unfathomable profundity of which language has no expression."

But let us now reflect a bit and learn a little of laboratory appointments and surroundings during a time when some of the epoch-making discoveries were formulated. Strange to state, the conditions of our earlier laboratories were deplorable even up to the latter part of the last century.

A number of the greatest scientific achievements have been attended with the crudest form of laboratory equipments imaginable, and under the most trying circumstances.

Perhaps this condition of affairs was largely responsible for their successful development.

A few interesting episodes in this connection taken at random from many sources will clearly show to what extent it was necessary to go in order to accomplish that which the investigator set out to do.

The early day scientists had no easy road to success, for they toiled in rooms and shops far from luxuriance and accommodations.

The earliest record we have of chemical laboratories is that found in the days of the Egyptian Pharaohs, where the temples had adjacent buildings presumably for chemical operations, since the hieroglyphics found written on the walls of these buildings point to the use of assaying, coloring and annealing processes.

Sir Robert Boyle, the father of modern chemistry, while investigating the "elasticity of gases," and who developed the law which now bears his name, used a tube of such length that he could not conveniently employ it in his laboratory room. He was therefore compelled to continue his delicate experiments by the use of the stairs in the same building.

It is also given from reliable sources that Newton performed all of his work on the "resolution of the light rays" in his lodgings at Cambridge. Our own but immortal Franklin, it is said, did most of his work at home by putting up insulated rods, seizing every chance he could to apply his tests when the air was heavily charged with electricity.

With Berzelius, who gave us many shining lights, matters appeared to be very homelike, for it is common talk that he carried on most of his experiments in the kitchen of his home where, it has been said, "cooking and chemistry went on together."

In the year 1824, Justus von Liebig, the founder of the modern chemical laboratory, established his laboratory at the University of Giessen. Its description was that of an old, dilapidated wooden structure, which was given him for the purpose of performing his experiments. Here he carried on his researches and taught students at the same time.

In this manner the question of agriculture was successfully given a scientific basis. The value of his labors has never been fully appreciated but perhaps realized for the wonders it has worked in the interest of crop productions. With Lord Kelvin things seemed to have improved but very little; for many years his laboratory was an old unoccupied wine cellar in one of the old university buildings at Glasgow.

In Lord Kelvin's physical laboratory experiments were conducted which made possible the laying of the Atlantic cable.

Claude Bernard, who has been termed by many "the prince of experimenters," toiled daily in an old damp cellar, one of those wretched Parisian substitutes for a laboratory which existed even up to but a few years ago in some remote places. Bernard gave it the appropriate calling of "The Tombs of Scientific Investigators." The case of Gay Lussac was very much the same, and in some respects both serious and yet comical. Gay-Lussac conceived the idea of wearing wooden shoes to protect his feet from the dampness of the cold ground. It is reported that he suffered severely with rheumatism, hence this novel means to enable him to continue his experiments without discomfort. It was Gay-Lussac who gave us Liebig.

This is a fairly good taste of scientific research under difficulties and reveals

a most worthy example of persistency that is beyond comparison. Such characters must have surely loved their work for there can be no doubt but what Gay-Lussac did. In a few unappointed, squalid rooms in Berlin, we are told, that H. G. Magnus taught and performed experiments to students from whence came such geniuses as the great Helmholtz and the famous Tyndall, the one-time railway engineer but later on a student under Bunsen.

At the *Ecole Normale,* situated in the *Rue d'Ulm,* just in the rear of the Pantheon, Paris, in close proximity to the Sorbonne, in a small one-story building, Pasteur made some of his famous discoveries. At first he had only one small room, but the place grew with his achievements until he occupied the entire building.

Dr. Roux, famous for his discovery of diphtheritic anti-toxin, did some of his best work in a very small room in the same building. He had not as much as a fireplace with which to add warmth and comfort to his surroundings.

Another was Louis Thuillier, after whom Rue Louis Thuillier was named. Though only a student, his bacteriological researches in the same building made him famous and caused a tablet to be erected in his memory for the self-sacrifice he made in the cholera epidemic in Alexandria. This unpretentious building containing, as it did, the laboratories of such great men, was given the name of "The Mecca of Bacteriologists."

Thus we have a reflection of the evolution of the laboratory in another direction.

In a once private dwelling two rooms were set aside as a laboratory at Heidelberg in the year 1846, by Prof. P. G. Jolly. Here was laid the cornerstone of the more modern laboratory. It grew in size and enlarged in accommodations to such an extent under the supervision of Bunsen and Kirchloff that their wonderful observations with the spectrum was thereby made a possibility.

One of the more recent cases and strangest of all was that of the Curies, who worked on radium. It has been given in print that the Curies developed radium and studied its properties under the greatest difficulties. The laboratory of Pierre Curie was situated in the school where he taught physics—"a small, single room, an inconvenient workshop and extremely unsuited for serious investigations, in fact almost unusable."

At the school of physics and industrial chemistry, where all of his researches on radium were made, "the installation was a miserable one, consisting of barracks made of boards loaned by the city of Paris." "The room used for physical experiments was smoky, low, dark, moist and cold." "It had none of the conveniences necessary for carrying out delicate experiments and had no plant for furnishing electric energy, heat or high temperatures." "As for the chemical laboratory that was more than ancient."

"In the large glazed shed there was to be found two plain modern tables for holding flasks, capsules and furnaces. On these tables all chemical operations were performed. There was no hood to carry away vapors, and every time there was a chemical reaction the room was filled with fumes that made the air irrespirable, so poor was the ventilation."

Lastly, Curie had no laboratory assistant other than his ambitious wife, who was before her marriage to Prof. Curie, Marie Sklodowska, a Polish girl, who shared with him in the greatest of all recent chemical discoveries, that of radium.

I am advised that only a few years ago was there much improvement in their laboratory surroundings, but owing to the importance of their discovery, the University of Paris enriched its laboratory equipment by installing more modern appliances.

As a reward to this noble little woman, the University of Paris tendered her the chair of radio-activity, which she accepted and, by the way, is the only professorship in that institution occupied by a woman.

In 1903 she shared with her husband half the amount of the Noble Prize awarded for work in physics. A few years later she was personally awarded the full prize for her work in chemistry. The research and experimental laboratory has grown to wonderful proportions within recent years, both on this and the other side.

Every institution of learning, regardless of the size, has some form of laboratory equipment connected with it. On the other side the laboratory constitutes one of the most important divisions of any institution needful of one, be it educational or industrial. Switzerland is not a very rich country, comparatively speaking, but Zurich boasts of its laboratories that have cost over 4,000,000 francs.

Germany's physico-technical laboratories, to which Werner Sieman has himself subscribed several hundred thousand dollars, are perhaps the most complete in the world. These were established in the fall of 1887.

In this connection consider the most beneficent gifts of Mr. John D. Rockefeller, of this country, to that of the research laboratories which bear his name. The Institute for Medical Research, under the able direction of Dr. Simon Flexner, is truly an institute of laboratories, to which Mr. Rockefeller has already given upwards of $12,500,000, which makes it the most thoroughly appointed institution of its kind in the world.

Editorially the New York *World* had this compliment to pay with reference to this most amply endowed medical institute:

"The achievements of the scientists engaged in its work had already made it one of the most useful and most famous. Some of them, indeed, have by their discoveries so advanced the sum of human knowledge concerning the causes and the nature of diseases as to have gained rank among the foremost of the age. It is therefore not merely wealth but science and genius and keen discerning labor that Mr. Rockefeller has by this disposal of a portion of his fortune placed at the service of human suffering."

The various laboratories of Cooper Union, New York City, where the penniless but ambitious boy, native or alien, has an equal chance for a scientific education with that of the richer in paid institutions, was made possible by the keen farsightedness of its benefactor, Mr. Peter Cooper.

This is the only institution of its kind in America, and perhaps the entire world, that came into existence and accomplished so much under circumstances most unusual.

Cooper Union maintains a high standard of education, which is advancing yearly. It occupies very expensive realty quarters and is independently supported. All of this has been amply provided for by its founder, Mr. Cooper. Its chemical laboratories alone are modern and spacious, completely equipped and efficiently managed by a corps of experienced instructors, many of whom have risen from the ranks.

From a small beginning the laboratories have grown to very large proportions, and during the last ten years have undergone many notable changes, so that to-day the chemical department stands as a most unique part of the entire institution, which is unsurpassed by any other of a similar nature.

Information leading to laboratory knowledge in chemistry, botany, physics and the biological sciences, is now being taught by mail by the extension department of the University of Chicago.

The laboratories at Glasgow now occupy palatial quarters in the new building of the university, where great prominence is given them.

The new medical laboratories of the University of Pennsylvania, costing over a half million dollars, are marvels to behold. Likewise, the various laboratories of Columbia and Johns Hopkins Universities are most modern and up-to-date.

Conceive the vastness of the laboratory forces of the United States Government as it concerns its Department of Agriculture alone, with over fifteen separate and distinct departments all equipped with laboratory facilities of the very best.

Take that of the Bureau of Chemistry and that of the Animal Industry alone. These are truly wonderful and powerful agencies in the world's economics.

A few others, like the Bureau of Standards, the Hygienic Laboratory of the U. S. Public Health Service, with its tributaries reaching into all parts of the United States. By its creation America has been immensely enriched, and its work conducive to a more healthy nation.

This, too, was not without its bitter trials, for as late as 1901 Congress approved a paltry sum of $35,000 for a new building for the laboratory on a site in the old naval observatory grounds at Washington.

Even fire and life insurance companies have been specially equipped with testing laboratories. Every asylum, sanitorium and health resort has its laboratory of some sort.

Deprive the various State agricultural experimental stations, the State and municipal boards of health, hospitals and clinics, the medical, pharmacal, dental, electrical and mechanical institutions of their research laboratories and you will then have destroyed the elements of their usefulness.

No private, public or academic institution of learning can dispense with its laboratory outfit.

Industries of every description feel and see the need of specialized laboratory equipments.

More recently, growing out of the European conflict, the United States Government has had in the course of formation one great research and experimental laboratory for the U. S. Navy, which will have a series of chemical, physical, electrical, mechanical and explosive laboratories. The cost of erection is to be $5,000,000, with an annual expenditure of a little over half the above amount.

The University College of London, realizing chemistry's importance in the future prosperity of the nation, has just completed the construction of a new chemical laboratory that will surpass in equipment anything of a like nature in the entire world. From this alone we are to understand that the research laboratory has become a strong factor in the industrial and economic relations of the universe. What a wonderful picture this would reveal to our old friend, the alchemist, if he were permitted just for a moment to observe its present vastness. What

would be his reply at just receiving a mere peep at the advancements and accomplishments growing out of his efforts these last few decades. Surely he would be amazed into speechlessness.

So we may pay homage to the toilers of alchemy of the "dark ages."

Praise them for their persistency and their desires, hopes and failures, for in a manner we may perceive how the mighty oak of our present laboratory has sprung up out of an acorn of ignorance and superstition.

And yet less than half has been accomplished.

HOW PHARMACISTS' WIVES MAY BE OF SERVICE TO THEIR COUNTRY.*

BY MRS. D. F. JONES.

We all love our country and how gladly have we responded to its call to do our bit, even if there are over twenty patriotic organizations for us to join, each one with an appeal we find hard to resist, we can only live one day at a time to produce the work required, and we must not become discouraged because we cannot accomplish everything.

The Red Cross work should come first in interesting pharmacists' wives, not only because of its close relation to the work of the pharmacist but for the alleviation of suffering at large. Money is most needed for this work, for the work must go on and we must aid in this labor of mercy, not only with money but time and effort as well. The article by Ex-President Taft in the June (1917) number of the *Ladies Home Journal* describes the object and work of the Red Cross so well that it is not necessary for me to repeat it, as everyone should be familiar with the work by this time.

I know of no other class of women more helpful than pharmacists' wives in times of peace, so I feel sure they are responding quickly to the rigid requirements of war. This World's War has made it both fashionable and patriotic to practice thrift which means making the best possible use of all we have in time, money, energy and material, and not trying to spend more of anything than we have. The slice of bread stares us in the face like an ogre and to see it wasted is a kitchen calamity. It would be a greater calamity if we served this same slice of bread once too often, for whatever we do in keeping war away from our borders, we must never let it creep over the threshold of our homes.

Because of our great excess of food we have become extravagant so we are admonished before throwing anything away to stop and ask ourselves the question: "Can it be used in my home or some other home?"

We, as women, are not in a position to play a large part in the actual fighting, but we can play a most consequential part in caring for those who fight for us and for their women and children. This we can do in our own homes and by encouraging and helping others to do so. We must aid the poorer classes in learning conservation, and I am glad we have societies organized to help the people of all classes to aid themselves. It is wonderful how quickly women have responded to this great call to service, and how efficient they have become in all phases of

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