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Education and the Electroplating Industry

by
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It is an added honor to receive this cherished award at the Golden Anniversary of the inception of the American Electroplaters' Society. I wish to pay tribute to the founders of this Society, and to the officers and members whose devotion and vision have made possible its great progress in numbers and accomplishments during the past fifty years. In my 45 years' association with the AES, I have known personally all of the officers and have respected and admired their ability and sincerity.

In connection with the studies of family genealogy that Mrs. Blum and I have conducted in recent years, we frequently recall the verse from Psalms: "The lines have fallen for me in pleasant places; yea, I have a goodly heritage." On this Golden Anniversary, the AES and its officers may well feel that they too have a goodly heritage to preserve and to pass on to their successors.

It is a special privilege to present this talk at this International Conference, at which many of our friends from Europe and Australia are present. It is hoped that some of the suggested activities will be of interest to these countries.

The success of the Russians in launching the first and other satellites represents an outstanding accomplishment of Russian science. We should recall that, contrary to the belief of many persons, Russia has made many notable contributions to science during the past century. For example, all scientists are indebted to D. I. Mendelyeev for his inception of the Periodic System in 1869.

Since 1957 no subject has probably received more consideration in this and other countries than the advancement of education, especially in science and engineering. Fortunately this movement has also emphasized the importance of a well-rounded education for all the rising generation, to better fit them to meet the pressing problems of our complex modern civilization.

The subject "Education and the Electroplating Industry" was suggested by my long association with the AES, in which I feel that my principal role has been that of a teacher. It would be presumptuous and untimely for me to discuss the broad field of education, which is challenging the best minds of today. I may be permitted to express a few personal opinions on this important subject.

The aim of education is not conformity with certain ideas or doctrines. This view was tersely expressed some years ago by a college president in his address to a graduating class. "Do not try to make others like you are; one is enough."

The chief goal of education is not the memorizing of facts. Certainly we must develop the memory so as to know and recall important facts. But it is far more helpful to know where to find needed facts and how to apply them and the laws and principles

derived from them, that is, to learn to reason and to think. An old proverb comes to mind. "Knowledge without thought is waste of time. Thought without knowledge is dangerous."

Please note that the title of my address is not "Education or the Electroplating Industry," but "Education and the Electroplating Industry." I will try to point out channels through which education may affect this field. If emphasis upon a single industry appears to be a narrow or provincial view, we should bear in mind that in our complex society each essential segment must advance to meet the new demands.

I will try to point out the needs and possibilities for improving the education of apprentices, platers, works chemists, research chemists, plant executives, designers and the purchasing public, the ultimate consumer of electroplated products. It is obvious that the AES cannot directly initiate or sponsor all of these activities. It may however endorse and encourage efforts made by other groups. Such a program should not represent a selfish effort to improve the status of electroplating and those engaged in it. Rather its chief goal should be to enable electroplating to contribute more efficiently to the health and welfare of our entire population in peace and in war.

Apprentice Training

There is still a need for intelligent, well informed persons, preferably high school graduates, to conduct or supervise the many manual operations that are involved in plating, even in highly mechanized installations. To become more than a laborer, a beginner should take every opportunity to learn the basic principles of the various operations and equipment, and the reasons for their adoption. Such knowledge can be gained through evening classes now conducted in many cities by the AES and by schools, through correspondence courses, and through study of technical journals and books. Young persons employed in plating plants can best learn the actual operations in the plant from a competent supervisor. It is not necessary for a school to install elaborate or large-scale equipment. Small tanks and appropriate laboratory apparatus are adequate and essential. The most important requirements for the success of the student are the interest and stamina that are needed to pursue evening courses after a hard day's work.

It is desirable that the teacher of such a course have sufficient knowledge of plating to point out the application of the subjects to industrial practice. But above all he should know his science and be enthusiastic and stimulating, qualities that are essential for all good teachers. Chemists engaged in plating plants may well teach such courses, or assist the teachers, even at a sacrifice of time and energy.

Plant foremen

While the so-called old-time platers are becoming less numerous, there are still many plating foremen with long experience and a prospect of many more years of service. Increased business and domestic responsibilities make it difficult for an older plater to attend classes. But only through better technical education can he hope to conduct efficiently the new processes and methods that are coming into use. The advent of chromium plating over thirty years ago challenged the ability and ingenuity of all platers. The present extensive use of bright plating of nickel and other metals has introduced new problems of operation and control. Even when the services of a chemist for analysis are available, the plater must know how to interpret and apply the results. He should also be able to read intelligently the papers published in technical journals, even though their authors sometimes fail to state their results in clear, simple language. We need foremen platers who appreciate and deserve opportunities for a better education. Whenever possible they should attend "refresher" classes, or take correspondence courses.

Work chemists

Too many college graduates assume that their education is completed when they receive their diplomas, when it has just commenced. Many works chemists are assigned, often incidentally, to duties connected with plating, such as analysis of the baths, even though they have never specialized in electrochemistry, much less in electrodeposition. Only through a study of advanced text books and journals can such persons contribute to progress in this field or indeed keep up with it. It is not enough to make rapidly an accurate analysis; the chemist should know what analyses are pertinent and what the results mean, not only for that day's operation, but for long-run production. He should be sufficiently interested in and familiar with the plating process and its requirements to serve as a "trouble shooter" or better as a "trouble preventer." He should keep up to date by study of text

books and journals, including those in related fields such as electrochemistry, metallurgy and physics, and take advantage of courses in these subjects. The practice and equipment used in other industries may prove applicable to plating.

The extensive use of large scale equipment for preparing and plating metals, purification of solutions, recovery of wastes, and ventilation, offers an attractive field for "plating engineers." As few if any colleges offer such a course, he must be first qualified in physical science and engineering, and then apply this knowledge to plating. Large scale plating offers opportunities for "automation," to extend much further than the use of automatic conveyors. "Feed-back" mechanisms, such as automatic devices for measuring the thickness, may be designed to control the current density or period in each step in the plating.

Research chemists

This title is inadequate, because any thorough modern study of electroplating processes involves the services of not only chemists with some knowledge of physical, electro, analytical, inorganic and organic chemistry, but also of persons with a knowledge of atomic and nuclear physics. All-around scientists are needed to solve the problems involved in the production of coatings to withstand the temperatures and pressures prevailing in rockets and satellites, and in plants producing or using atomic energy. To cope with such problems the chemist must know more about the "unusual" metals that are now finding important uses, and more about the electrochemistry of non-aqueous systems.

It is unlikely that a person with all these qualifications, if such a person exists, could be induced to conduct studies in electrodeposition. The obvious solution is for the research chemist to learn enough about the modern advances in science to know when they may prove helpful; and then to secure the advice or assistance of a specialist in that field. I am reminded of a short course in commercial law that I took as an undergraduate student in chemistry. The professor emphasized that its purpose was not to enable us to dispense with the services of a lawyer, but rather to know when to hire one.

To an increasing degree, intensive research in any field of science requires the services of many groups, including mathematicians, physicists and chemists. Such an assemblage is possible only in large research laboratories maintained by universities, industries and the government. The cost of maintaining such a corps of scientists may appear prohibitive, but it is the only way to economically conduct extensive and intensive researches.

One of the most promising directions toward solution of problems in electrodeposition is the acquisition of new approaches and new technics. The progress made in atomic and nuclear physics in recent years may suggest methods of attacking problems that have baffled solution by the hitherto conventional methods. For example, radioactive tracers have thrown light on the mechanisms of certain plating processes. It is in this field that younger scientists are most likely to succeed, because they have not only learned the new concepts and theories; they can also make them a part of their thinking. Those of us who studied science fifty years ago may with sufficient effort understand most of the modern advances, but it is difficult for us to make these new concepts guide our thinking.

Every scientist over fifty years of age can benefit from a "refresher course," such as the "Continental Class Room Course in Physics for the Atomic Age" that has been given on television during the past year. My life-long habit of early rising, and the absence of office hours, made it easy for me to listen to most of these lectures, given from 6:15 to 6:45 a.m.! I did not attempt to take the examinations required for credit! But I did succeed in recalling many facts and principles that I had virtually forgotten, and in getting authentic even though elementary concepts of the problems involved in nuclear physics and in missiles and satellites. A similar course in chemistry recently prepared by Dr. J. F. Baxter and available for broadcasting in the fall, may benefit most of us even though electroplating may not be mentioned.

There is no simple solution for the necessity for specialization and the equal importance of broad scientific knowledge. It is certain that a person with a bent and desire for scientific research should receive in both undergraduate and graduate studies the broadest possible knowledge of mathematics, physics and chemistry. He can then intelligently select that field of science which most appeals to him. Specialization can then be acquired in the research laboratory. Concern has been expressed over the comparatively few colleges that offer specific courses in electrochemistry. For prospective engineers and works chemists, such courses may be very valuable. But to conduct fundamental studies in any branch of electrochemistry, a broad knowledge of modern science is the best foundation.

Another means of bridging the gap between the specialist and the general scientist is the writing of text books, articles and lectures in which the latest developments of science are interpreted and applied to specific problems. Symposia of two or more societies may point out the possible applications of new discoveries and concepts. In general such explanations can best be made by the fundamental scientists, provided they are willing to learn the status and needs of the specialists.

Plant executives

Thus far this talk has been devoted to those persons who have a direct connection with and responsibility for plating operations. However, the ultimate decision as to whether plating is to be used on certain products, and whether a plating plant should be installed, rests on the management, as represented by the plant executive. To make an intelligent decision he must receive information and advice from members of his staff, consultants and suppliers. To understand and interpret such reports, he should have knowledge of the purposes for applying plated coatings, and their advantages and limitations as compared with competitive finishing processes. There is no existing textbook on plating for executives, who in any case would be unlikely to study it. The responsibility rests upon the works chemists or consultants to educate the executive before making specific recommendations.

It is important to emphasize those purposes for which plating is not wisely applied. Every unsuccessful application of plating renders more difficult its appropriate uses. Emphasis should be placed on high-quality plating, since the cost of the plating operation is usually a small part of the total cost of the finished article. But its quality may determine the salability and life of the product. On an automobile sold for $3000 or more, the purchaser is not concerned with whether the plating cost $25 or $50 per car, but with whether the finish will last for one or for five years.

Design engineers

The actual type and extent of plating may be specified on drawings by a design engineer who has little knowledge of plating processes. The appearance of an automobile or a toaster is an esthetic question that involves psychological factors that are not susceptible to scientific analysis. But whether a certain device or part can be efficiently coated by plating is a very practical problem, on which qualified platers have had much experience. The most obvious difficulty is that of applying a coating of the required thickness and quality on sharp edges and in deep recesses. If such designs are insisted upon, troublesome and expensive devices such as auxiliary anodes and "thieves" may be required. The design engineer should therefore be advised or instructed to prepare designs that are artistic and can still be readily plated.

The purchasing public

The existence of the plating industry depends upon a demand for, or at least an acceptance of, plated coatings on a large proportion of the metal articles used in the household, office or school, and in our complex system of transportation, entertainment and sports. Few of these consumers are conscious of the presence of the plated coatings, unless perchance they are so inferior as to become conspicuous. Some people's concept of plating may resemble that implied in the old conundrum: Teacher - "What is the first thing to turn green in the spring?" Pupil - "Christmas jewelry."

The problem of informing the public about the plating industry, its products and its contributions to modern living is essentially a question of public relations, to which the AES has given serious consideration. The following approaches are suggested with a full realization that each will require careful study to determine whether it is practicable and expedient.

Increased use of specifications. To gain the respect of the public for plated coatings, they should to the greatest extent possible be of good quality for the purpose intended. This does not imply that all plating should meet the highest standards. Articles for transient use, such as paper clips and safety pins, do not warrant the application of thick coatings, but they should be well plated.

In the last 25 years the AES, ASTM, IMF and many firms have adopted specifications for plated coatings, which have in general improved the quality of these finishes. These standards are extensively employed in the plating of parts of automobiles and appliances, but not so widely in the plating of the very large number of miscellaneous articles thus coated. Unfortunately the existence and use of these specifications has not assured consistent production of coatings of high or even satisfactory quality.

Inferiority of many plated coatings from 1950 to 1956 was explained and excused by the shortage of nickel available for plating during and for some time after the Korean conflict. As no fully satisfactory substitute for nickel in plated coatings was developed, manufacturers of automobiles applied the best coatings they could and advised the car owners to "treat the plating carefully." This unavoidable period of admittedly inferior plating has placed electroplating on the defensive in the minds of the public.

Now that adequate nickel is available, it behooves the industry to produce coatings of such high quality that the public will again prefer plated finishes. While the present wide use of bright nickel plating is fully justified by the savings in the cost of polishing and buffing, it has introduced certain new problems regarding the uniformity and adequacy of the protective properties of the coatings. This problem offers a real challenge to the researches of the AES and other groups to discover the causes and remedies for the failure of nickel-chromium coatings in service, and thus to improve their quality to a satisfactory level. Fortunately, substantial progress is being made through such studies.

Quality marks. Coatings consisting of precious metals such as gold and silver are frequently designated by "quality marks," that are generally accepted by industry, even though not in all cases required by law. For example, silver plated flatware may be marked "Triple plate," which corresponds to "six troy ounces of silver per gross of teaspoons." This represents an average thickness of about 0.0008 inch of silver. An additional thickness, known as the "overlay," may be applied to areas subjected to most wear, and be indicated by suitable symbols. For example, teaspoons with triple plate plus an overlay may be marked "AAA+," or "XXX+." The present system of marking silverware may be misleading, since the lowest marked grade bears the letters "A-I"! While the purchaser does not usually know the basis of the marks, he at least understands that if it is marked "triple plate," it is a high grade for household use. The marking of silverware is not required, but if it is so marked and fails to meet the standards set by industry, the producer is subject to action by the Federal Trade Commission.

The marking of electroplated gold coated articles is less common. Certain articles such as watch cases, with rolled-gold or gold-filled coatings, must bear quality marks, such as "1/10-18 K," which means that one-tenth by weight of the article consists of a coating that is 18/24, or 75 per cent, pure gold. The marking of very thin gold electroplated coatings as "24 K gold plated" is discouraged as misleading, even though the coating consists of pure gold. Articles may not be marked "Gold Electroplate" unless the coating has a minimum thickness equivalent to at least seven millionths of an inch of pure gold. If the coating has a minimum thickness equivalent to 100 millionths of an inch of pure gold it may be marked "Heavy Gold Electroplate."

The use of quality marks for precious metal coatings is based primarily on the intrinsic value of the silver or gold. Actually this may be a misleading factor. For example, six troy ounces of silver may cost $6.00, or about four cents per teaspoon, and a gross of triple plated teaspoons may be sold retail for $60.00 or more. Hence the cost of the silver may represent only 10 per cent of the selling price. While this cost of silver is not negligible, the purchaser is not concerned with how much silver he gets, but with the quality and life of the articles. Similarly, a small piece of jewelry such as a ring may weigh about one-fifth of a troy ounce. If it is coated with "0.1-12K" gold, the total weight of the gold is one-hundredth of an ounce, or 35 cents worth. If this ring is sold for five dollars, the value of the gold is only seven per cent of the selling price.

I have included this information about the marking of articles coated with gold or silver to indicate that quality marking of other plated coatings may be even more warranted. In connection with plating specifications, there have been discussions about the marking of the finished products to indicate the grade of plating. On an automobile with many plated parts, local marking would probably be impractical. But the advertising literature might well include the quality of the plating in accordance with designated specifications. Just now it may be more important to improve the quality of the plating to a degree that warrants calling attention to it. But in the future such marking may well add to the stature of plating.

Exhibits. At this and certain other AES conventions, expositions of plating equipment and supplies have been held. These are directed primarily to persons engaged in plating, to acquaint them with the progress in this field. The public visitors to such an exhibition may gain a wholesome respect for the complexity and ingenuity involved in this industry, but are unlikely to learn much about how or why plating is applied.

In New York, Philadelphia and Chicago there are large industrial and scientific museums, in which are displayed attractive models of equipment used in many industries. Certain of these exhibits can be operated by pressing a button, to illustrate vividly the way the process works. Each year thousands of people visit these museums and are fascinated and enlightened by their observations. Many of these visitors are of high school age, a very impressionable period. It is safe to assume that all of these

visitors carry away some impressions that may influence their thinking and their purchasing habits. High school students may there gather ideas that may influence their choice of a vocation.

I sincerely believe that the plating industry would find it advantageous to have an exhibit in each of these museums. Such a display might include methods of plating and the uses of plated products. A small automatic plater might be installed, which would plate small souvenirs that may help to retain the interest of the visitors. The annual expense of such an exhibit is relatively small and could appropriately be shared by the AES, the supply houses, and large manufacturers and users of plated products. It has been conservatively estimated that the plating of metals in USA adds at least 500 million dollars annually to the value of manufactured products. It would not be extravagant to spend annually about fifty thousand dollars, that is one-hundredth of one per cent of the cost of plating, to acquaint the purchasing public with the uses and value of plated finishes.

Popular articles on plating. Where can an average person, be he lawyer, doctor, business man, salesman, or mechanic, learn anything authentic, interesting or useful about electroplating? Encyclopedias, even if kept up to date, can devote little space to such a restricted field. Some of our high class magazines such as *Fortune* have at times carried interesting, well illustrated articles on specific industries. Here is a challenge to the plating industry, to prepare articles on electroplating that will show clearly to the public its possibilities and limitations, its problems and their solution, the choice and care of plated coatings, and evidences of quality by appearance or quality marks.

Newspaper publicity. The metropolitan dailies in the large cities in which the AES must perforce hold its large conventions afford little space for publicity of these meetings, usually at most a short article on the principal speaker or the elected officers. It should be possible for the AES to select for each convention some report or development that is of sufficient general interest to warrant publicity. The Educational and Publicity committees of the AES might well cooperate in this effort.

Conclusion

I believe that education in its broadest sense and application is the most important problem that now confronts the plating industry. The international associations of platers, such as the AES and the IMF, are organized and operated primarily to advance education in this field. They should initiate or support all efforts that will enable this industry to compete effectively in our complex society, now appropriately known as the "Space Age." We must prepare to fill our proper share of that space!

About Dr. William Blum

Dr. William Blum, considered to be the grand old man of electroplating and metal finishing, was born in Philadelphia on December 28, 1881, and was educated in the public schools of Philadelphia. When he graduated from the Central High School, he received a scholarship to the University of Pennsylvania where he studied chemistry under Dr. Edgar Fabs Smith, who was one of the earliest Honorary Members of the AES. And in his senior year, Dr. Blum studied electro-analysis, which initiated his interest in electrochemistry.

From 1903 to 1909, he taught chemistry at the University of Utah where he came into close contact with the copper and lead mines and smelters. In connection with studies on smelter smoke pollution, he frequently climbed 250-ft smelter stacks to sample the discharged gases (This was the greatest height he attained until, in later years, he became addicted to flying in airplanes.).

During the summer vacations and the academic year of 1907-1908, he was a Graduate student at the University of Pennsylvania where he received his Ph.D. in 1908.

In 1909, he became a chemist at the National Bureau of Standards (NBS) in Washington, D.C., where he engaged in analytical researches under Dr. W.F. Hillebrand, a world-famous analytical chemist. In 1913, he was assigned to investigate the cause of certain difficulties encountered in the copper electrotyping baths at the U.S. Government Printing Office. During the next few years, he studied the factors involved in the operation of these baths and published the results in NBS Circular 52.

The close similarity between electrotyping and electroplating led him to attend, in 1915 in Dayton, Ohio, the Convention of the American Electroplaters' Society (AES) which he then joined and with which he became closely associated.

During World War I, to meet the needs of military agencies on electroplating problems, three experienced electroplaters, all members of the AES, were added to the staff of the NBS Electroplating Section viz: Fred J. (Dad) Liscomb, Thomas F. Slattery and George B. Hogaboom. The latter association led to the joint preparation in 1924 of the first edition of "Blum and Hogaboom," a title more often used than *Principles of Electroplating and Electroforming*. This book was revised in 1930 and again in 1949.

During the interval from 1913 to 1951 when he retired, Dr. Blum directed the work of the NBS Electrodeposition Section, in which a total of over 100 men and women have been employed. Many of these persons continued their interest in electrodeposition after they left the Bureau to accept industrial positions. Over 100 technical papers on plating were published by the group, chiefly in the *Monthly Review* of the AES (later *Plating* and *Plating & Surface Finishing*); the *Transactions of the Electrochemical Society* and the *Journal of Research of the National Bureau of Standards*.

Dr. Blum was richly rewarded by numerous honors in recognition of his scientific activities. The AES made him an Honorary Member in Philadelphia in 1919, partly in recognition of three papers presented there on war-time studies in which Liscomb, Slattery and Hogaboom cooperated. In 1928, the AES presented him with a gold watch which he used regularly and cherished highly. He was also an Honorary Member of the AES Research Board in which he took an active part.

He was an Honorary Member of the Electrochemical Society of which he was President in 1926-27. In 1944, this Society presented him with the Acheson Medal.

The Institute of Metal Finishing (formerly the Electrodepositors' Technical Society) conferred Honorary Membership upon him and he presented the Hothersall Memorial Lecture and received the Hothersall Medal in London in April 1954.

He had taken an active part in the work of Committee B-8 of the ASTM in the preparation of specifications for electroplated coatings. In 1951, the ASTM gave him an "Award of Merit."

The University of Pennsylvania conferred the honorary degree of Doctor of Science upon him in 1953, and the Franklin Institute of Philadelphia awarded him the Elliot Cresson Medal in 1953.

In 1926, the American Institute of Chemists awarded their first medal to him for "Distinguished Governmental Service." In 1951, the U.S. Department of Commerce presented him with a medal for "Outstanding Contributions to Science."

During both World Wars I and II, and after the latter conflict, he served as an advisor to the War and Navy Departments, and after 1951, he was a part-time consultant to Frankford Arsenal in Philadelphia and Rock Island Arsenal in Illinois. In 1951, Frankford Arsenal made a special unique award to him for his service in this capacity.

In 1953, the American Chemical Society awarded him a certificate for 50 years membership and made him an "Emeritus Member."

In 1958, Dr. Blum was the first winner of the AES Scientific Achievement Award, which ultimately was named in his honor.

Dr. Blum became well acquainted in the field of electrodeposition in other countries. In 1935, he presented a paper to the Faraday Society in London and visited many plants and laboratories in England, France, Germany and Holland. In 1953, he spent four months on a trip to Australia and New Zealand, where he gave over 25 lectures on plating and related subjects to AES Branches and to other scientific societies, and visited many plants and laboratories. In 1954, Mrs. Blum and he spent three months in England and the Continent after the International Conference on Electrodeposition and Metal Finishing in London.

Dr. Blum died in Winchester, Virginia on December 7, 1972. He was 90 years old.