AN AEROSOL AGE EXCLUSIVE

WHAT STARTED THE BILLION DOLLAR AEROSOL INDUSTRY

HOW IT ALL BEGAN

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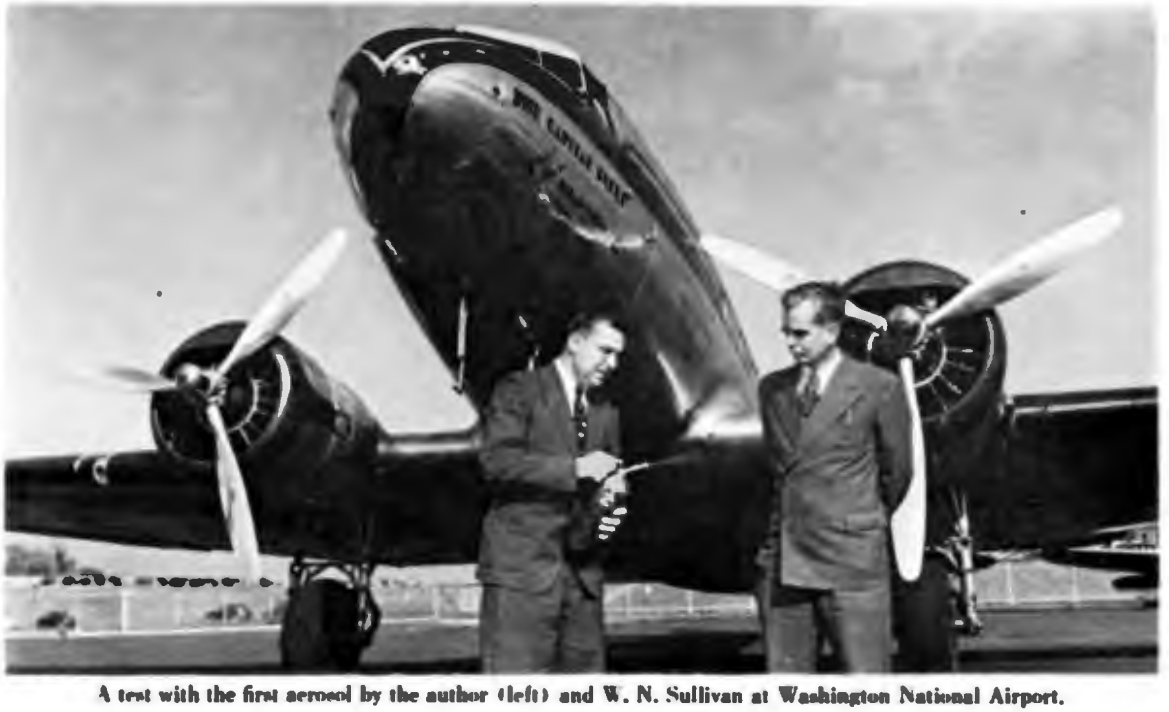


A test with the first aerosol by the author (left) and W. N. Sullivan at Washington National Airport.

MANY versions have been written as to how today's aerosol industry began, but none of the authors has been in possession of all the facts that led to the birth of this fabulous packaging business. This article is intended to record a part of the early history and development, most of which has not appeared in print. Sometimes success is a matter of luck, but having the major ingredients for success ready and in the right place at the right time are paramount prerequisites. World War II, the need for mosquito control, an enthusiastic partner, and acceptance by the armed forces were essential ingredients. Also, what could compare with the advertising of over 40 million free samples to start any industry?

Several articles on the history of the aerosol reveal that some earlier inventors conceived the idea of a self-discharging package. Probably the most comprehensive histories were written by Shepherd and other contributors to his book on aerosols[1]. All the antecedents to our invention are mentioned so they need not all be reviewed again here. Up to the time of Rotheim, by no stretch of the imagination were the crude proposals for pressure packages designed for the production of commercial packages.

The first noteworthy contribution to the process of dispersing substances by spraying solutions in liquefied gases under their own pressure was developed by Eric Rotheim in Norway[2,3]. However, his patents went almost unnoticed until the American aerosol industry was well established, probably because of his untimely death and because his

U. S. patents were held by the Alien Property custodian during World War II. A good account of Rotheim's contributions was reported by Edelstein[4] in a previous issue of *Aerosol Age*. However, Rotheim's invention lacked several of the important ingredients necessary for success. His formulations were *flammable*, since only flammable propellants were available to him. Also his invention was timed wrong in a country where even the American version of aerosols has been relatively slow in becoming fully established.

Another contributor was Carl Iddings in 1937[5], who seems to have gone completely unnoticed by aerosol historians. His patent covers the refrigeration method of filling and even lists "Freon 12", among other propellants. Also an attempt to dispense insecticides by spraying solutions in propane was made by George L. Hockenyos[6] in 1937. After several tests, it was abandoned because of the flammability hazard.

LOOKING back, it is not difficult to see the reasons for success which for the purpose of this article are termed "ingredients".

When the author was working in the former Bureau of Entomology and Plant Quarantine at Beltsville, Maryland, nicotine was used as a greenhouse fumigant. Because rapid volatilization was needed, a method involving dispersion by releasing a solution in a liquefied gas was proposed. The idea was recorded and witnessed by Dr. F. L. Campbell, then in charge of the laboratory. This notebook page, dated October 5, 1935, and a following

Some of the Rothheim units, made in 1937

page, dated October 16, 1935 and recording an extension of the idea, are shown on this page. The writer had no knowledge of previous work on such a system. The initial idea was not tested at that time because no safe containers were available to handle such highly toxic substances as nicotine. However, this record marks the earliest date of conception of the modern aerosol.

Approximately three years later, W. N. Sullivan and the writer began working as a team on insecticidal smokes produced by the incomplete combustion of derris and pyrethrum[7]. This evolved into spraying solutions of insecticides on a hot surface to form aerosols by the volume condensation method[8]. The aerosols were tested for the control of various insects, including roaches, flies, and even fungus gnats in mushroom houses. Our teamwork continued and several hundred chemicals were tested as

Oct. 5, 1935

The idea has been conceived that a mixture of alphatic chlorides of fluorides of mixtures or compounds containing both halogens whose boiling points are below room temperatures, could be mixed with nicotine and used as a fumigant.
The liquid mixture would exit enough pressure to forcefully spray the contents of a cylinder. The rapid evaporation would disperse the nicotine as a fog.
Some of the compounds suggested are

CH_2Cl	Bp. -23
CH_3F	" -78
C_2H_5F	" -32
C_2H_5Cl	+12

Most of these compounds are not inflammable.

CO_2 in liquid form might be used.

Lyle D. Goodhue

Witnessed by F. L. Campbell
Oct 5, 1935

Ideas, Suggestions etc.

Oct. 16, 1935

If rotenone, derris extract or cube extract are soluable in liquid CO_2 or some inert chlorofluoro compound it could be sprayed out in a fine mist which would evaporate to leave a cloud of dust particles.
Could be used with any solid soluble in some liquified gas.

1 pyrethrum
2 phenothiazine
3. rotenone
4. —

The author in the laboratory at Beltsville, Md. At left is the first 2D aerosol bomb ever made. At right is the filling equipment used.

insecticides in aerosol form for cockroaches. At one time we had 19 public service patents on synergists for insecticidal aerosols[9].

The use of the scientific term "aerosol" was applied by this writer to cover these air colloids and it was subsequently used in all publications. Because this word was also a trademark for a series of emulsifiers, Roark[9] explained the scientific term and justified its use. Now the word "aerosol" has evolved to include almost *any* self-dispensing pressure package.

During the week of April 7, 1941, Bill Sullivan and the writer were asked to appear in Washington to review our work on aerosols for Dr. P. N. Annand, at that time director of research of the Bureau. Reasons for continuing the project would be needed. Since we were somewhat apprehensive about the future of our project, we decided to drag out my old idea recorded back in 1935. On Saturday, April 12, 1941, the writer purchased five pounds of "Freon 12" from the General Electric Supply Co. in Washington, D. C. The "Freon 12" was placed in an empty five-pound ICC-9 cylinder. The next day, Easter Sunday, the author, working alone in the chemical laboratory at Beltsville, filled what was for all practical purposes the first modern aerosol bomb. A mixture of pyrethrum and sesame oil was sucked into an evacuated second cylinder. The exact amount was not recorded. "Freon 12" was then transferred into the second cylinder by gentle heat. A Monarch brand oil-burner nozzle of low capacity (2 gal. per hour) was attached to the 45° angle valve on the container. A cage of American roaches was available from other previous testing. Several roaches were placed in a small glass fumigation case and a charge of the aerosol was introduced. In less than ten minutes all roaches *were on their backs*. The writer yelled with joy and excitement!

Sullivan was given the good news by telephone and in the afternoon he, J. H. Fales, and the writer (accompanied by wives, children, and by Sullivan's girlfriend), gathered at Sullivan's Entomology Laboratory. Flies in the Peet-Grady chamber were sprayed and the results were similar to those obtained earlier that day on roaches. Enthusiasm ran high throughout the group.

ON Monday we carried this device to the proposed meeting on aerosols. We arrived early and gave demonstrations to individuals and small groups. Some saw in it a great future, while others left the room in what appeared to be disgust. (It should be mentioned that the crude pyrethrum available was quite irritating.) No organized meeting developed and we went back to Beltsville with our new toy.

Our patent application, filed on July 29, 1941, described a method of producing parasiticidal aerosols. Since it was limited to a "true aerosol", with particles that would remain suspended in air for long periods, very little prior art was cited. However, both Iddings[5] and Rotheim[2] *were* cited. The patent[16], assigned to the Secretary of Agriculture, was issued on June 8, 1943. The claims specified less than 10% nonvolatile ingredients, to ensure that a true aerosol with particles below 50 microns diameter would be produced.

One successful test followed another. Through Sullivan's personal contacts at Walter Reed Hospital and with the U. S. Public Health Service, many official requests for demonstrations were received and conducted. These included the treatment of bed bugs in an animal room at the National Institute of Health and of roaches in several mess halls in the nearby military centers. An aerosol containing 1.0% total pyrethrins with 2% sesame oil was

found to be highly effective against mosquitoes and showed great promise as a means of controlling malaria and other mosquito-borne diseases. A paper on toxicity of pyrethrum aerosols to mosquitoes was read at the Eastern Branch Meeting of what was then the Society of Economic Entomologists at Baltimore in Nov., 1941[11].

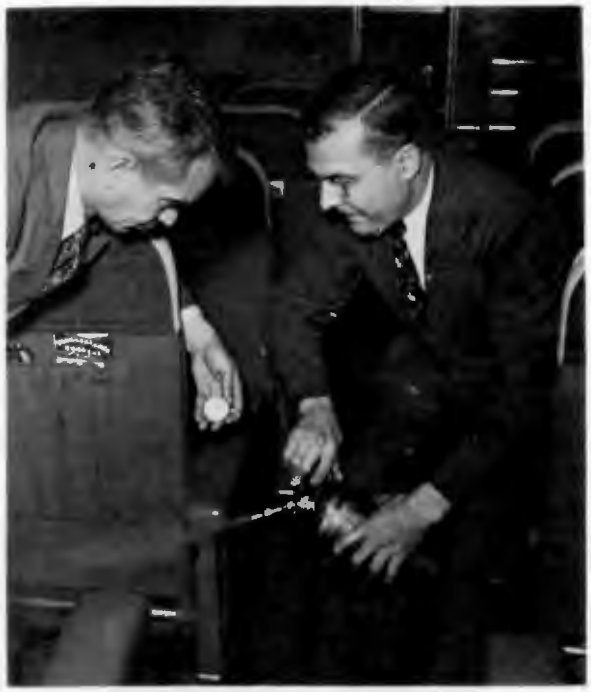
It has been incorrectly stated by some writers that the Department of Agriculture was *commissioned* by the armed forces to develop the aerosol bomb. This is not accurate. The idea was sold to them by W. N. Sullivan after the development was well under way. However, in April 1942 when Sullivan was given a commission in what is now the Air Force and was sent to Wright Field, things began to hum. Through his contacts with Westinghouse in Springfield, Mass., that company (with his assistance) developed the first practical aerosol bomb. It is of interest that the term "bug bomb" or aerosol "bomb" originated with Westinghouse employees because the container in physical appearance resembled a small bomb. Actually, the bomb was adapted from a small "Freon 12" container, already in commercial use for charging household refrigerators. Before the end of the

Left: first Westinghouse aerosol bomb and (right) first unit from Armstrong Engineering Co.

War over 30 million units were produced by Westinghouse and over 10 million by three other companies[1]. Both the Army and the Navy used the aerosol.

Nearly all of these military aerosol "bombs" contained the original pyrethrum-sesame oil formulation, but subsequently a pyrethrum shortage necessitated successive reductions of the active ingredient. Near the end of the war a very effective pyrethrum-DDT formulation was substituted, but few of these reached the theaters of operation before the war ended.

ALTHOUGH at the time there were many arguments over the merits of aerosols versus fly sprays, many people saw a great future in the civilian use of the aerosol, not only for insecticides but for dozens of other uses.



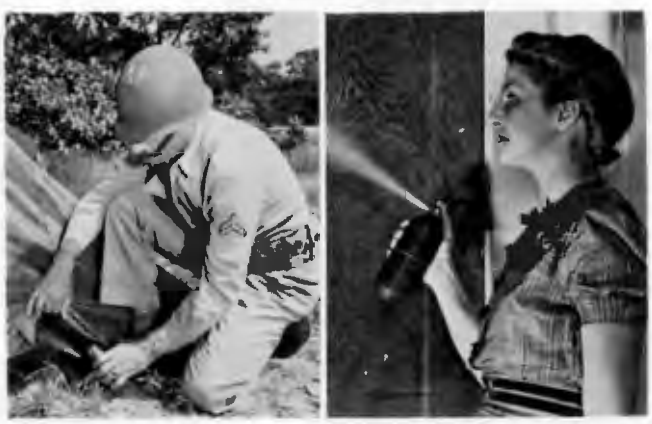
Messrs. Sullivan and Goodhue test early unit in a DC-3 at Washington National Airport.

The cost of the high-pressure container was an obvious handicap, but this was soon overcome by the use of the lower pressure aerosol we know today. While the writer was employed by Airosol, Inc. in Neodesha, Kan., beer cans were adapted and the first low pressure aerosols were marketed. The first shipment on November 21, 1946 consisted of 105,000 Crown cans[12], that were purchased and reworked to accommodate a valve designed by that company. Although not very successful (mostly because of leakage difficulties), these in effect were the first commercial low-pressure aerosols, at a time when a pressure below 25 psig was required.

Now it may be time to reflect on why the Goodhue-Sullivan aerosol was almost immediately successful, where previous attempts failed. The answer is that the proper ingredients for success suddenly came together. They are

(*Continued on Page* 118)

Military and civilian use are illustrated in these USDA releases dated early 1943.



How It All Began

(*From Page* 33)

listed as follows, not necessarily in the order of importance:

1. The timing was right. It became available when there was an urgent military need. Also, it preceded DDT, which would have so overshadowed the aerosol as to give it little chance.
2. It was a nontoxic, nonflammable, compact unit that met military specifications for use in combat areas.
3. It was very effective for its primary purpose, i.e., mosquito control.
4. The project was enthusiastically supported by our respective organizations headed by R. C. Roark and L. A. Hawkins and by the contributions of J. H. Fales in the laboratory.
5. Sullivan, with his great enthusiasm and promotional ability, was an essential ingredient without whom there would have been little chance of success.
6. The distribution of 40 million free samples provided unsurpassed free advertising to prime later civilian use.
7. It was developed in a country receptive to gadgets and accepted by people with the means to purchase them.

Great changes have taken place in the aerosol package during the last 20 years. Probably the mass production of high quality valves has contributed as much as any one factor. Also, great improvements have been made in formulations. At first the aerosol would not have been successful without fluorinated hydrocarbons. However, beginning with the first tank car shipment of hydrocarbon propellant by Phillips Petroleum Co. in May, 1956, safe formulations using hydrocarbon propellants have helped expand the industry to even greater volumes than foreseen by the pioneers.

It is hoped that this resume of the early days of the modern aerosol industry has given proper credit where due and clarified some of the early events that sparked the industry. ★

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PharmaPlastics

(*From Page* 58)

to new quarters. At its present location, the company occupies 21,000 sq. ft. of a larger 43,000 sq. ft. building, which it owns.

In the molding room, there are seven up-to-date injection molding machines, with a range of from four to 12 oz. capacity. These machines are worked on three shifts and due to the new quarters there is plenty of room for expansion of the molding room.

PharmaPlastics has in its assembly department lines for wrapping, hot stamping, bagging, assembling and other finishing operations. In addition to the company's line of aerosol caps and components, PharmaPlastics also does a large volume of business in standard pharmaceutical and cosmetic packaging fitments, including medicine droppers.

Warren Richards is president of the company and Joseph W. Parker is vice president. Both are firm advocates of the importance of quality cover caps in "setting off" the entire aerosol package concept. ★

Shulton uses PharmaPlastics cap.

Shulton Adds New Division

Shulton, Inc. Clifton, N. J., has just announced the formation of the new Franchise Cosmetic Division, to be headed by A. J. Bender Jr. as managing director. The new Franchise Cosmetic Division will devote its efforts to the leading cosmetic and toiletries retailers throughout the country, by means of a separate sales force. This division will sell and promote Shulton's existing lines of toiletries as well as new, exclusive lines currently in final stages of completion. These new lines will make their trade debut in June, for fall retail promotion.

Assisting Mr. Bender, as manager of marketing services, will be John Wood, previously in Shulton product management, and two field sales managers—Gerald Gurley and Jack W. Wilson—both former Shulton district managers.

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MM&R Holds Sales Meeting

Magnus Mabee & Reynard, Inc., New York producer of essential oils and perfuming materials, assembled its sales representatives from Maine to Florida in New York March 5-6, for a sales and technical conference. The meeting was held primarily to brief the salesmen on plans for a drive to make 1965 — the company's 70th anniversary — the most prosperous year in the history of the company.

New products were discussed, sales problems analyzed, and a realignment of some of the territories arranged to permit more efficient coverage. New perfume oils were explained by Gosta Hedstrom, director of the quality control laboratory, and others.