S U M M A R Y

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T E C H N I C A L P R O G R E S S

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INTRODUCTION

At the beginning of a new year, it is customary to take stock and review progress. No new records were established for the quantity of work performed by the laboratory during 1940, but a high order of accomplishment was established for research work.

One thousand seven hundred forty-nine raw material shipments were inspected (1,827 were tested in 1939); 17,692 batches of finished products were tested (18,601 were tested in 1939); and 1,797 new products were developed (2,307 were developed in 1939).

Technical developments during 1940 were, quite naturally, colored by war and the threat of even more war. Independence of imported raw materials--especially tung and perilla oils--loomed as our primary and biggest research problem.

TUNG AND PERILLA OIL SUBSTITUTIONS

Raw material suppliers took full advantage of the oil situation by exploiting every conceivable resin and oil as substitutes. In consequence, much effort was wasted in investigating these highly exploited but valueless substitutes. One of the few really promising raw material developments in the drying-oil field in 1940 was contributed by Armour & Company.

This development involves the fractional distillation of semi-drying oils, such as fish and soya oils, into drying and nondrying constituents. The drying constituents are being marketed in two forms--(1) as fatty acids (tradenamed Neo-Fats) split from the oils; and (2) as tailor-made synthetic oils, in which these fatty acids have been recombined with glycerin (tradenamed Neo-Fat TG; TG meaning triglycerides). Thus far, the Neo-Fats have not been widely adopted because of high cost, limited production, and objectionable odor (fishy).

When oil shortages occurred in previous years, substitutions in our products never passed the discussion stage. In 1940, considerable progress was made in adopting substitute oils. As a result of this work, our consumption of perilla oil decreased 35 per cent during 1940; China wood oil consumption decreased 20 per cent; and linseed oil consumption jumped 54 per cent. (These figures have been adjusted for differences in production between the years 1939 and 1940.) During 1941, our consumption of perilla oil will decrease another 30 per cent as a result of changes made late in 1940. At the subsidiary manufacturing companies, perilla oil has been completely eliminated from all formulas, and China wood oil

consumption has been reduced 42 per cent. Oil substitutions made in 1940 will save the company about $50,000 per year as long as the current price structure remains.

To date, our use of substitutes has narrowed to three raw materials--Synthenol, a dehydrated castor oil which is particularly useful as a perilla oil substitute; oiticica oil; and linseed oil treated by the processes developed by Mr. Armstrong two years ago. The following table illustrates how our consumption of drying oils has shifted in recent years:

Ratios of Various Oils Consumed at Buffalo

Year	Perilla Oil	China Wood Oil	Linseed Oil	Oiticica Oil	Synthenol	Total
1929	10	57	33			100%
1935	7	65	28			100
1938	19	55	26			100
1939	23	55	22			100
1940, 1st half	19	47	*34			100
1940, 2d half	8	49	*40	1	2	100

* About one-fifth of the linseed oil now used represents treated linseed oil.

These figures on oil consumption tell only part of the story. During 1940, 161 listed items, or about three-quarters of the standard products containing China wood oil and perilla oil, were revised to utilize substitutes. These 161 items represent over a third of the 436 items listed in Price Schedules P116 and L116. We are beginning the year 1941 with this third of our listed items made on an entirely different basis from what it was a year ago. Industrial products have been just as widely changed as our listed products.

Formula changes always involve a great deal of painstaking checking and rechecking. Wholesale changes such as those made during 1940 offer unusual hazards. The fact that these changes were made without visibly affecting quality and without unfavorable criticism from customers or salesmen is a tribute to Mr. Zimmer, Mr. Armstrong, Mr. Schultes, and the many others who contributed to this work.

Research on oil substitutes constituted one quarter of all research expense during 1940. It cost the company $7,376.

RAW MATERIALS

In addition to oil shortages, war has affected many other raw materials. Most titanium dioxide is manufactured from imported ores; during the past year, a domestic titanium dioxide was approved. French-process zinc oxide has become scarce as a result of abnormal demand for zinc metal; we are now examining an American-process oxide which we hope will breach this shortage. Coal-tar solvents are needed for explosives and consequently are scarce. Petroleum distillates which have heretofore been available as substitutes for coal-tar solvents have disappeared because of abnormal demand. Italian Sienna has joined the list of materials which are no longer available. The Canadian raw material situation has been even more trying than our own. Important as these materials are, the actual shortage of China wood oil and perilla oil is, and continues to be, the most serious threat to the continued quality of P & L products. The investigation of substitutes will continue to be an important part of our 1941 research.

During the year, 48 new raw materials were adopted for general use. Of these new materials, another resin type was added to the ever-increasing number of synthetic resins.

This was melamine resin, which is made by reacting melamine and formaldehyde. Melamine was first synthesized over a century ago by the German chemist, Liebig; but it remained a laboratory curiosity, selling at $40 per pound until recently. With industrial production on a tonnage basis, the price has dropped to 55 cents per pound. Cyanamid is the starting point in the manufacture of melamine. Melamine resins resemble urea resins and produce mar-resistant, color-permanent, porcelain-like coatings when baked. Satisfactory air-drying melamine coatings are not available. K1207, a high-bake (5 minutes at 325° F.) melamine white, and K1206, a low-bake (1 hour at 200° F.) melamine white, were developed by Mr. Mehrhof and Mr. Miller during 1940. About 350 gallons of the two products were sold during November and December of 1940.

Alkyd resins are being more widely used in our products every year. During 1940, 27 per cent of all new products contained some alkyd resin. This represents a 35 per cent increase over 1939, when 20 per cent of our products contained alkyd resin. In 1935, only 11 per cent of our new products were so formulated.

TRADE SALES DEVELOPMENTS

Effecto, the Outdoor Enamel, was our leading trade sales development during 1940. Like most recent developments, the new Effecto employs an alkyd-resin base (U. S. formulas) and thus represents

another departure from traditional oil-base formulation. The new Effecto line was developed by Mr. Johnston and Mr. Brewster. Research expense totalled $474.94.

Our Vitralite Automobile and Railway Enamels were also changed to an alkyd basis during the year (by Mr. Johnston), thus improving quality, decreasing cost, and reducing consumption of perilla and China wood oils. The revised Vitralite enamels are more durable than the Effecto line.

The most durable of all our alkyd-resin enamels is the Vitralex line of automotive finishes, but this line has been losing headway, competitively, because of poor print resistance. During 1940, $4,883.56 was expended on research work directed toward the improvement of the Vitralex line. This problem has been carried along for over five years, during which time we have probably spent a total of $15,000 on research. Literally hundreds of experimental resins have been examined, including products of resin manufacturers as well as resins of our own production. Gradually an improved product has been evolved which we believe will place us in a favorable competitive position. The finished product employs an unusual resin in which alkyd and phenolic constituents have been cooked together. A new thinning principle has been employed whereby the inactive solvents are rapidly volatilized. Last of all, soluble naphthenate driers have been substituted for the resinate driers previously employed. All factors combine to make an improved product. This work has been carried on by Messrs. Armstrong, Mehrhof, and Miller.

An improved Household Aluminum Paint was developed by Mr. Schultes during the year. While this item is relatively unimportant from a sales viewpoint, the new ready-mixed paint with its superior metallic appearance is a vastly better product and represents an important technical development. Like many developments, ready-mixed aluminum finishes were of no interest to our sales organization until competition started to exploit similar products.

House Paint Exterior Primer was materially improved during 1940, thus overcoming its previous defects--slow drying and high luster. The hiding was also greatly improved. These improvements were achieved with a three-cent-per-gallon cost reduction. House Paint Outside White was also reduced in cost (by nine cents per gallon) with no apparent reduction in quality. The change in Primer and Outside White will save our company about $11,000 annually. House Paint 5 Outside White was a revolutionary development, the work on which was completed during 1940. If this paint should be adopted as our first-grade house paint, it will mean an additional saving in raw material costs. All three paint developments were carried on under the supervision of Mr. Zimmer.

Considerable work was done on floor paint during 1940 by Mr. Zimmer. "61" Floor Enamel Steel Gray and Silver Gray, improved alkyd products, were developed, and an entirely new, lower-cost Floor Paint line was worked out.

INDUSTRIAL DEVELOPMENTS

Metal Decorating Trade

Considerable strides were made during the year in the development of finishes for the metal decorating trade. This work is now handled exclusively by Mr. Johnston and Mr. Hoffman.

Two tung-oil-free finishing varnishes (M4610, M4586) were formulated using treated linseed oil which hardened in an extremely short baking time--13 minutes at 240° F. Two thousand five hundred gallons of these varnishes have been sold since April 15, 1940, when they were first offered. One thousand six hundred gallons of an alkyd finishing varnish have also been sold since that date. This varnish (KC196) is the palest finishing varnish so far developed and has been used successfully over printing inks, where alkyds formerly struck in and leveled poorly.

Two low-priced, tung-oil-free sanitary lacquers (M4616, M4617) were also developed in 1940 to meet competition in this field. While these lacquers are not so resistant as our highest-grade sanitary lacquers, they are satisfactory for most food products. Two thousand seven hundred gallons have been sold since June 12, 1940.

Two ureaformaldehyde tin coatings developed during the year seem outstanding and should lead to substantial business. One is a white cap coating (G24503) which bakes whiter than previously used coatings and which fabricates and vulcanizes (contacts with rubber inserts at elevated temperature) satisfactorily. The other is a clear finishing varnish (KC207) which bakes with an exceptionally fine color in 7 minutes at 300° F.

Other Industrial Developments

Wrinkle finishes continue to be popular in the industrial field, where 11,533 gallons were sold during 1940. This represents a 25 per cent increase over the previous year's business and an infinite increase over 1938, when the license agreement was signed with New-Wrinkle, Inc. During 1940, two air-dry wrinkle finishes (G24836 and G24843) were developed. While these dry harder and faster than any competing products so far examined, the term "air-drying" is a somewhat ambitious descriptive term.

The problems of the Carborundum Company occupy a large part of the time of the Varnish Formulating Laboratory. The Carborundum Company reports that their industrial and repaint sandpapers are better than any which they have previously manufactured, and that they have regained several previous automotive accounts and have more than doubled their repaint sandpaper business. The adhesives developed by Mr. Schultes during 1940 are responsible for much of this reported superiority. During the last four months of 1940, fifteen thousand gallons of improved adhesives were sold to the Carborundum Company. Laboratory work for the Carborundum Company cost the company $2152.14 during 1940.

A rather unusual white enamel was developed for stove parts by Mr. Mehrhof. This enamel resists color change at such extreme temperatures as 400° - 500° F.; practically all ordinary white enamels yellow or are destroyed at temperatures above 300° F.

An unusually durable and resistant clear furniture lacquer, 9503, was developed by Mr. Mehrhof. 9503 resists cold checking, alcohol, and hot water to a marked degree. Seven hundred gallons have been sold since November, 1940.

Several developments pertaining to defense purposes are of particular interest. A flame-resistant lacquer (containing ethyl cellulose) was developed for use on upholstery for tanks, trucks, and airplanes. A reduced-visibility aircraft finish for night flying was investigated. It was found that an intense, no-luster black gave best results. New camouflage finishes were developed for aircraft use. These contain Acryloid resin as the basic constituent and are designed for either direct application to metal or over an old lacquer finish. A special remover will strip the camouflage without appreciably affecting the base lacquer. Some work was also done with luminescent paints, which are being widely used in the war zone for identifying objects during blackouts.

Heretofore, shellac has been widely used as a primer on rubberized upholstery fabric prior to application of lacquer finish coats. During 1940, Mr. Mehrhof and Mr. Hart developed lacquer base primers (100-38, 100-39, and 100-41) which offered better elasticity and adhesion than the previously used shellac primer. Six hundred thirty gallons were sold during the year. These shellac substitutes are applicable to rubber only; they are unsuitable for other uses. In the rubber field, an accelerator known as Butyl 8 is widely used in compounding. Mr. Avallone suggested the use of this product in rubber lacquers, where it was found to produce harder and more abrasion-resistant lacquers at no sacrifice in adhesion and flexibility.

Probably our biggest single lacquer account is the wall tile division of the Armstrong Cork Company. A tremendous amount of

laboratory work was done for this account during 1940 by Mr. Mehrhof and Mr. Mellan, resulting in the development of 59-467, White Lacquer. This lacquer is much superior to the lacquer which has been supplied during the past, but it is also more costly. Credit for the improved lacquer belongs to our competition, as the threatened loss of the account forced us to improve quality and decrease selling prices.

A great deal of time was also expended on problems for the Markel Electric Fitment Company, manufacturers of inexpensive lighting fixtures. High-bake synthetic white enamels (K1175 and K1193) were developed by Mr. Mehrhof and Mr. Miller for use on automatic spray and baking equipment. Eleven hundred gallons of these two products were sold. Dozens of other special items were also developed and sold to this account.

PERSONNEL

Labor turnover amounted to 7 per cent in 1940, the same as in 1938 and 1939. Changes in 1940 involved four transfers to other divisions, two resignations, and two discharges. Four individuals were not replaced.

COMPLAINTS

Complaints followed the same pattern as in previous years. A total of 248 were registered with the laboratory during 1940; 264 were registered in 1939. Twenty-two per cent of the complaints pertaining to products manufactured at Buffalo and Fort Erie were justified; 42 per cent of the complaints pertaining to products manufactured at the subsidiary companies were justified. Three factors continue to cause about 40 per cent of our complaints--color, drying, and viscosity, with color accounting for more than any other single cause.

SOCIETIES AND ORGANIZATIONS

The laboratory was represented at the spring meeting of the American Chemical Society at Cincinnati, Ohio, by Mr. Armstrong. Mr. Lutz attended the annual meeting of the American Society for Testing Materials at Atlantic City, New Jersey. In the latter organization, the company is represented on all committees pertaining to paint products. During 1940, Pratt & Lambert collaborated in ASTM research work on driers, resins, and weather testing. The laboratory is also represented in the Western New York Club of the Federation of Paint and Varnish Production Clubs by Messrs. Johnston, Lutz, and Zimmer. Mr. Zimmer is now vice-president of the Western New York Club.

LABORATORY EXPENSE STUDY

During 1940, laboratory activities were subjected to a careful expense study, based upon time records covering the entire year's work of all laboratory employees (other than those engaged in nonproductive or purely "overhead" tasks). From these records, the Accounting Department has calculated the "costs" of all jobs performed by the laboratory. "Costs" for the entire year were about 10 per cent less than actual expenditures. This discrepancy was due primarily to lack of previous experience upon which to base departmental rates.

The expense study was undertaken because of the following interrelated laboratory problems:

Special sales problems have increased so materially in recent years that research has been crowded into the background. The growth of these special sales problems is best illustrated by the record shown below:

Year	No. of Special Sales Problems Completed During Year	Av. No. of Employees Engaged in Research & Formulating Work
1934	1056	23
1935	1227	27
1936	1477	28
1937	1547	29
1938	1435	27
1939	1569	26

During the above pericd, special sales problems increased numerically 49 per cent, but formulating personnel increased ohly 13%. Most of this increase in sales work resulted from an increase in the number of industrial problems, as the amount of work for other sales divisions has remained fairly constant.

By January 1, 1940, the accumulation of special sales problems had crowded research activities so badly that the laboratory was over a year behind in examining new raw materials. Mounting labor costs had already increased laboratory expense prohibitively, so an increased personnel seemed unwise. On the other hand, continued failure to keep abreast of current developments would have ultimately proven costly.

It was the laboratory's belief that some of the less important sales problems could justifiably be sacrificed for research work which would benefit the company as a whole; and that this could

be accomplished by increasing the expense of special sales problems. Beginning April 1, 1940, higher charges were initiated for laboratory work. The effect of these charges on requests for laboratory work (especially those involving lengthy jobs) and the degree to which research has benefitted, is illustrated by the following table:

	Allocation of Laboratory Effort		
Month 1940	Special Sales Problems	General Research	Manufacturing Services
Av. first 4 months	47%	22%	31%
*May	36	32	32
June	30	35	35
July	27	36	37
**August	21	28	52
Av. last 4 months	26	34	40

* First month when higher charges affected work for sales departments. Higher charges initiated in April.

** May through August was a period of liquidation for old Industrial Sales problems. A concerted drive was made during this period by the Industrial Sales Department to decrease laboratory problems.

Research work is now fairly well in hand. The more important raw material developments are being investigated within a reasonable time after their announcement. The present distribution of time between research and special sales problems represents a more healthy balance than the relationship that existed a year ago.

The decrease in time spent on special sales problems during 1940 made it possible to decrease instead of increase formulating personnel. The total number of employees engaged on formulating work dropped from 27 in January to 23 in December. If expenses had continued at the rate established during the first four months of 1940, total laboratory expenses for the year would have been $7,000 to $10,000 higher than in 1939. Actually, expenses were one per cent higher than in 1939.

In recent years, charges against the sales departments for laboratory work have represented only a fraction of the cost of that work to the company. The expense study showed that laboratory charges during the first four months of 1940 amounted to slightly less than half the actual cost of the work. Beginning in May, 1940, laboratory charges were gradually increased until December, when actual costs were billed for all sales work.

During the years 1933 through 1939, when special sales problems were increasing so rapidly, the average charge per sales problem dropped from $17.00 in 1933 to a low of $9.38 in 1938--not because the problems were easier and less work was involved, but because the old charging system depended on the human element. Charges for work were fixed by the individual doing the work and were based solely on his estimate of the value of the work. No records were kept to substantiate charges, and as a result there was continual bickering about charges, especially with the Industrial Sales Department. Accounting records and not guesswork now provide the basis for making charges. The individual doing the work no longer plays a part in "fixing" charges. During 1940, which covered both old and new charging systems, the average charge per problem rose to $14.30.

The present change in our laboratory charging system probably saved the factory about $10,000 during 1940. At the end of March, 1940, the net expense of the laboratory was $1,685 higher than it was in 1939. If this rate of increase had continued throughout the year, the net expense for the year would have been about $7,000 higher than in 1939. The net expense for the year was actually over $3,000 less than it was in 1939. The $10,000 potential total should ultimately contribute to lower goods costs.

Any change in laboratory charges is a vital concern of the Industrial Sales Department, as 71 per cent of all work done by the laboratory in 1940 on special sales problems was for the benefit of the Industrail Sales Department. In spite of the dominance of industrial work, the Industrial Sales Department contributed only 42 per cent to the expense of special sales work. In dollars and cents, this means that $9,246 of 1940 laboratory expense, for the benefit of the Industrial Sales Department, was absorbed by the factory, where it was ultimately distributed in the form of higher goods costs. Part of this $9,246 contribution by the factory was in the form of a direct subsidy of $2,280.

Higher charges have had one desirable effect on industrial sales laboratory problems. In the past, problems were frequently put into the laboratory, where they were promptly forgotten. Weeks or months later, after work had been completed, sales conditions had often changed, so that the work had lost its value. Increased charges have made the Industrial Sales Department cost-conscious, and all problems are closely followed. "Dead" problems are promptly cancelled. The net result has been improved service.

The time study has revealed many surprising facts. We have always assumed, for example, that our finished product control costs were low and that they amounted to about 15 per cent of all laboratory expense. All formulators spend a portion of their time on control work. In 1940, the expense study showed that finished product control amounted to 26 per cent of total laboratory

expense. Other manufacturing services (raw material control, small batch manufacture, manufacturing problems, and the handling of complaints) accounted for another 9 per cent of the total expense. The remaining 65 per cent represents formulating and research expense. The following table shows an accurate breakdown of laboratory costs, according to function, for the year 1940:

	Cost per Gallon	Cost per Batch	Cost per Dollar of Sales (incl. Paint but excl. subs. sales)
Special Sales Probs.	2.2¢ } 4.0 (65%)		1.0¢ } 1.8 (64%)
General Research	1.8		.8
Finished Prod. Control	1.6	$1.66	.7
Other Mfg. Services	.6		.3
Total - 1940	6.2¢		2.8¢
Total - 1939	6.0¢		2.9¢

Note: The N. A. M. has just completed a survey of research budgets which reveals that a typical company spends 2% of its gross sales income for research. Pratt & Lambert research (i.e., special sales problems and general research) cost 1.8% of 1940 gross sales.

In summary, the laboratory expense study and the resulting change in our system of charging for sales work brought about the following:

(1) Research activities were increased in 1940 at no additional expense to the company but with an actual decrease in personnel.

(2) Sales departments now pay for laboratory work exactly what that work costs the company. Bickering over charges and cut-rate jobs have been eliminated.

(3) The sales divisions closely follow laboratory work and cancel "dead" problems in order to keep down costs. Laboratory service has been improved.

(4) It is estimated that the factory gained $17,000 in revenue during the year--$10,000 from increased sales department charges and $7,000 from decreased personnel.

CONCLUSIONS

The laboratory made a very creditable showing during 1940, doing the job for which it is paid. It was almost self-sustaining, as it will save the company an estimated $63,000 (annual basis for oil substitutions, revisions in house paint and primer, and other revisions) in 1941 as a result of work done in 1940; and it received $33,198 in credits for sales work. This $96,198 total amounts to 83 per cent of total laboratory expense and is considerably in excess of general research and sales problem expenses.

One phase of our technical work deserves some thought. The number of really new products which our company has pioneered within the last decade has been woefully small. Many new products have been developed, but they have usually been copies of competing items. We are probably the most successful imitators in the industry. Pioneering is expensive, and it can be dangerous, but our own course may be equally costly in the long run.

The laboratory itself is partly responsible for this condition. The organization, excluding the laboratory, is also responsible, as constructive suggestions and guidance in new product development from outside the laboratory are rare. It would seem as though our sales organization should be closer to merchandising trends and consumer wants and should be in a position to offer specific suggestions relative to new products and new fields of endeavor. If the laboratory received numerous suggestions, at least one or two ought to be profitable subjects for research.