SUMMARY OF TECHNICAL PROGRESS

1 9 4 1

Technical activities in 1941 were strongly influenced by the defense program which was then beginning to affect business and economic conditions. As a result of increased factory production, our control laboratories handled a greater volume of work than during any year in the last decade (2,527 raw material shipments tested in 1941--42% more than in 1940; 21,688 finished batches tested in 1941--23% more than in 1940). The record presented by our research laboratories was a rather surprising contrast to this, for fewer sales problems were handled and fewer new products were developed in 1941 than during any year in the same ten-year period (1,741 sales problems and 1,627 new products in 1941--both representing 9% less than in 1940).

This record of sales problems for the entire year tells only part of the story. The month-to-month trend during the latter part of 1941, as shown in the following table, provides an unhappy forecast for 1942:

	Number of Sales Problems Received by Laboratory		
Period	1940	1941	Percentage Change
First Half of Year	981	1,000	2% increase
Third Quarter	463	377	19% decrease
Month of October	163	145	11% decrease
Month of November	155	110	29% decrease
Month of December	125	82	34% decrease
Entire Year	1,887	1,714	9% decrease

The number of sales problems handled by the laboratory is primarily a measure of industrial sales activity in developing new accounts. This effort is diminishing rapidly because of raw material shortages, priorities, and the partial cessation of normal civilian activities.

Research

Under normal conditions, the decline in sales problems would be a signal for drastic reductions in research and formulating expense. However, the 1941 decline was accompanied by a 20% increase in general research work. Unfortunately this research effort was and is being directed toward counteracting the disruptive forces affecting our raw materials and not toward product improvement. It is of interest to note that only a fifth of the 343 research problems assigned during 1941 pertained to finishes; the remainder of the problems involved raw materials.

In 1941, 164 research problems were completed. About one out of every five completed problems was a success. The criterion for judging success was whether the results could be applied to products now being sold. A mere gain in knowledge was disregarded. Problems which are still active represent an investment of about $45,000 in labor and materials.

Research activities during 1941 resulted in estimated savings of $27,800 during the year and about $51,800 on an annual basis (1940 base). Unfortunately many of these gains have been invalidated by the freezing of China wood oil.

Almost daily shortages of raw materials required continual formula juggling in 1941. In many instances, formulas were changed more than once, as first one material and then another became unobtainable. Substitutes had to be found for already substituted materials. Literally thousands of formulas were changed during the year, but no reduction in product quality was necessary in any U. S. formula and no complaints were received which could be directly attributed to the changes. In Canada, we were less fortunate in dodging the stigma of inferiority, for the curtailment of zinc oxide necessitated reductions in quality in that country.

Everyone's attention is now focused on the need for formulating without China wood oil. Our ability to do this quickly does not hinge on work which we could do now, but upon work which has been intensively carried on for the past two or three years. In 1940 we spent $7,376 on oil research; in 1941 we spent an additional $10,852. The fundamental work has now been done and we are reaping the benefits. Our problem today, serious as it is, is merely an extension of an already familiar problem--not a baffling new one. This is an excellent case for the cause of research.

In addition to oil difficulties, resin shortages have been particularly inconvenient. Some of the disadvantages of the so-called "soft" oils can be overcome by cooking them with very hard phenolic resins. The shortage of these resins has thus been a keen disappointment in reformulating with less or no wood oil. Amberol F7 and Amberol 801 have been the backbone of our varnish formulas in the past. Both are phenolic resins; neither is readily obtainable; and neither has an equal among competing resins. We have, however, found two fairly promising substitutes--one a phenolic and the other a terpene resin. The laboratory investigation of Amberol substitutes cost $1,924 in 1941.

The necessity for doing without certain raw materials has had its benefits, for we have investigated fields that were never before particularly appealing. For example, we found a domestic pigment which is a very satisfactory offset for expensive imported English china clay at only a fraction of the latter's cost. A second illustration is afforded by "61" Quick-Drying Floor Varnish, where a decrease in China wood oil actually resulted in improved serviceability.

Several new and interesting raw material developments occurred in 1941. Improved hiding titanium pigments were offered, tested, and adopted in many products. These new pigments have a so-called "rutile" crystal structure, whereas the conventional pigments are termed "anatase" products. These rutile titanium pigments will save us about $10,000 per year by enabling us to use less pigment without sacrificing hiding. Like every other good thing, the rutile pigments have one disadvantage--a slightly yellow color which precludes their use in whites. Another pigment development of importance was an improvement in the grinding qualities of chrome greens. While the actual saving that this represents is hard to compute, there is a saving in operating time which is by no means unimportant.

The lack of tin forced us to investigate terne plate cans. Insofar as we have been able to determine, these have no technical disadvantages. The scarcity of tin has had some compensation, for we have been working with the American Can Company in developing coatings for use on greasy black iron as a substitute for tin. A trial order amounting to two drums is now being tested.

Trade Sales Developments

Probably our greatest achievement during 1941 was the completion of work on the improved print-resistant Vitralex line. This development culminated five years of intensive work by the Messrs. Armstrong, Mehrhof, and Miller. Over $7,000 was spent on this problem during 1940 and 1941, and it is probable that at least $10,000 in addition was spent during previous years. Unfortunately, this development has now lost some of its commercial significance because of our inability to secure raw materials.

The development of our new oil stains was a purely routine job but it cost the company $1,011 for laboratory work--primarily because of the many changes in the decisions on color.

Early in 1941, "61" Actinic-White Enamel Eggshell was materially improved in leveling, thus making it one of the finest eggshell enamels of our manufacture. "61" Actinic-White Enamel Gloss was also improved to an equally striking degree, but raw material difficulties have prevented our adoption of the improved formula. Both of these developments were handled by Mr. Zimmer. They represent an expenditure of $1,632 for laboratory work.

Mr. Zimmer has also developed an improved series of Verdura Trim and Shutter Finishes, but these have never been presented because of the raw material situation.

Improvements in "61" Quick-Drying Enamel White with respect to hiding and "staying put" properties have likewise been shelved because of raw material problems. In the course of our experimental work, two very interesting formulas were developed--one an alkyd and the other an oil-base material. When conditions return to normal, we have a choice of these alternate formulas. The developmental work cost $398 and was handled by Mr. Johnston.

Interior Gloss was changed to a "stay-put" type of enamel during 1941, following experimental work which was conducted by Mr. Zimmer.

Several of our Lyt-all products were improved during the past year as a result of work which was carried on by Mr. Johnston. The drying and hardening of Double Duty Primer was accelerated, thus making it a more acceptable painter product. Lyt-all Undercoating and Lyt-all Eggshell were improved in hiding. A modification of Lyt-all Flowing Flat is now under consideration by the Chicago Office. This modified formula offers reasonably good washability over glue size, according to laboratory tests. The development work on this formula has cost $1,172 to date.

We have recently developed two products as a result of the country's interest in civilian defense. These products, "Blackout Paint" and "Luminous Paint," have been sold only to a very limited extent.

Industrial Developments

In the industrial field, the problems of the Carborundum Company have always been an important factor in our laboratory work. In 1941, the Carborundum Company bought 66,686 gallons of our products, but the sale of this enormous volume required only $954 worth of laboratory effort (including 15 service calls). Several new developments were submitted, including materials for infra-red curing. Mr. Schultes personally handled all technical matters pertaining to this account and is undoubtedly instrumental in retaining this account.

From a volume standpoint, Zinc Chromate Primer complying with Navy Department Specification P27b was the biggest single industrial item sold in 1941. Sales amounted to 32,700 gallons.

Despite volume sales, this primer was and is one of our most fertile sources of complaint. Some factor is always causing difficulty. Unlike most products of our manufacture, Zinc Chromate Primer P27b is not well balanced but is in reality a technical misfit. Five-minute drying, freedom from settling when reduced with three volumes of thinner, good water resistance, and good package stability are the requirements, which are difficult to meet collectively. In 1941 alone we spent $1,196 on laboratory effort, and the problem is still not solved.

White Coating, G20289, for the American Can Company, is another industrial item which developed an exceptionally good volume in 1941. Twenty-seven thousand gallons of G20289 were produced, although the basic formulating work was done several years ago under Mr. Johnston's supervision.

A surprising volume was also shown by Black Coating, G22242, a defense product sold to several accounts for application on the sheet metal ends of cardboard shell cases. In 1941 this amounted to 16,400 gallons. Laboratory development work was done prior to 1941 by Mr. Johnston and Mr. Hoffman.

Wrinkle finishes continued to be popular in the industrial field, where 20,400 gallons were sold during 1941. This represented a 76% increase over the previous year's sales. Mr. Johnston and Mr. Hoffman have been responsible for the successful development of these finishes.

Heretofore most woodworking and furniture plants have employed air-drying varnishes. During the past few years, we, as well as other manufacturers, have spent considerable time in developing baking varnishes for this field. In 1941, we manufactured 16,100 gallons of low-bake (110°-150°F.) flat varnishes M3633, M4385, and M4539. Mr. Schultes has just completed work on a series of high-bake (250°-350°F.) varnishes. Experimental evidence indicates that these high temperatures can be attained without injury to either the wood or glued joints by using infra-red lamps. These finishes (KO216, KC226, KD13) are now being tested by several accounts; and one of these, the Western Electric Company, is displaying keen interest.

A major portion of the laboratory's work for the Industrial Sales Department in 1941 was on defense items. These have included camouflage lacquers and dopes for the U. S. Army Air Corps, non-specular lacquers for the Navy, synthetic lustreless enamels for the Quartermaster Corps, engine enamels for aircraft, and shell enamels. These were developed by Mr. Mehrhof and Mr. Miller and have resulted in substantial sales.

A coating for the rubber liner of bullet-proof (self-sealing) gas tanks has been an interesting defense development which has resulted in the sale of 550 gallons of material. This coating prevents gasoline from softening and dissolving the rubber liner until the tank is pierced by a bullet. When this occurs, the rubber swells, thus closing the opening made by the bullet, and the plane is able to continue its flight. Work on this development has been under Mr. Mehrhof's supervision.

An unusual lacquer was produced for machine tools by Mr. Mehrhof. This lacquer can be applied over oily surfaces without the usual loss of adhesion. It successfully seals the oil in place.

A water dip lacquer was also developed by Mr. Mehrhof. Metal parts wet from washing operations can be dipped in this lacquer. The water on the metal surface is replaced by the lacquer and sinks to the bottom of the dip tank where it can be withdrawn.

Personnel

From the discussion thus far it might seem that raw material shortages constituted our main worry during 1941. This was only one of two major difficulties. Personnel matters constituted the other problem.

The year 1941 had hardly begun when our first laboratory employee was drafted. About two-thirds of our entire laboratory organization was found to be subject to the Selective Service Act. As the year unfolded, these men were classified as follows by their local draft boards:

Class IA	(subject to military service)	6
Class IH	(reached age limit before classification)	1
Class IIA	(deferred for industrial reasons)	3
Class IIIA	(deferred because of dependents)	24
Class IVF	(deferred because of physical defects)	2
Total		36

The five men who actually entered the army included valuable employees, for whom we were unable to justify industrial deferment.

The uncertainty shown by local draft boards was a source of expense and exasperation. One man's case is a typical example. For a period of eight months, this individual waited for his notice to report for induction. During this time, we trained two replacements for the man, one of whom was himself drafted. Finally the original man was deferred for physical reasons, although he had been initially classed as physically fit. Thus about $1,000 in training effort was wholly wasted on our part.

The initial impact of the draft had hardly worn off when employees began to leave us to secure more lucrative defense positions. Several employees left our employ without giving notice, thus creating a serious replacement problem. The draft and booming defense industries have absorbed most of the young men of 21 to 26, whom we would normally employ as replacements. As a result, we have been forced to hire boys between 17 and 20. The average age of the 22 new laboratory employees hired in 1941 was 19 years. This has created another problem. These young men lack the stability and judgment of the mature men that they have replaced. Some have little serious interest in their jobs, and their loyalty and dependability are unknown factors.

Our method of securing new employees has undergone a change. We formerly relied on newspaper want ads and received from 50 to 80 replies to a one-day advertisement. An advertisement in March, 1941, brought only fifteen replies, none of which was interesting. In 1941, we received most of our new employees through the Dean Employment Agency and some through the New York State Employment Agency. It is now impossible to secure young men through either of these agencies, so we have started to employ women for routine technical work. We now have three such employees.

Labor turnover during 1941 amounted to 40%--the highest since 1929, when the turnover was 72%. During 1938, 1939, and 1940, laboratory labor turnover was only 7%. Reasons for employee releases are tabulated below for the past three years, as well as for 1929:

	1941	1940	1939	1929
Transfers to other departments	3	4	1	4
Resignations	11	2	3	27
Discharges	3	2	--	20
Drafted	5	--	--	--
Total Releases	22	8	4	51
% Turnover	39	7	7	72

It was literally necessary to hire two replacements to fill each vacancy created during the past year in order to secure one "permanent" employee. Half of the new employees hired during 1941 left after an average of only 17 weeks of employment. Fifteen per cent of our present laboratory organization has been with us less than 6 months; 30% has been with us less than 2 years. A laboratory employee is unable to work independently with less than two years' experience. Offsetting these statistics, there is the encouraging fact that the average period of employment for all laboratory employees is 8.6 years.

Labor turnover is bad for morale and is also costly. Time spent in training new employees and in rectifying their errors easily cost the company $10,000 during 1941, or about 10% of the laboratory's entire payroll. Time spent on personnel problems is time lost from research activities and creative work. Normal laboratory service was maintained only because department heads and other key men filled the gap by working longer hours and by personally handling a great deal of detail formerly delegated to assistants.

Labor problems during 1942 will probably be even more discouraging, as we are likely to lose about eight additional employees in the new draft.

Our laboratory personnel have been active in various scientific groups. Five members of the technical organization belong to the American Chemical Society--three at their own expense. Three belong to the Western New York section of the Federation of Paint and Varnish Production Clubs, of which Mr. Zimmer is now president. The company holds a membership in the American Society for Testing Materials and is represented by Mr. Lutz. During 1941, the laboratory was represented at the spring and fall meetings of the A.C.S., the annual meeting of the ASTM, and the annual convention of the Federation of Paint and Varnish Production Clubs.

Equipment

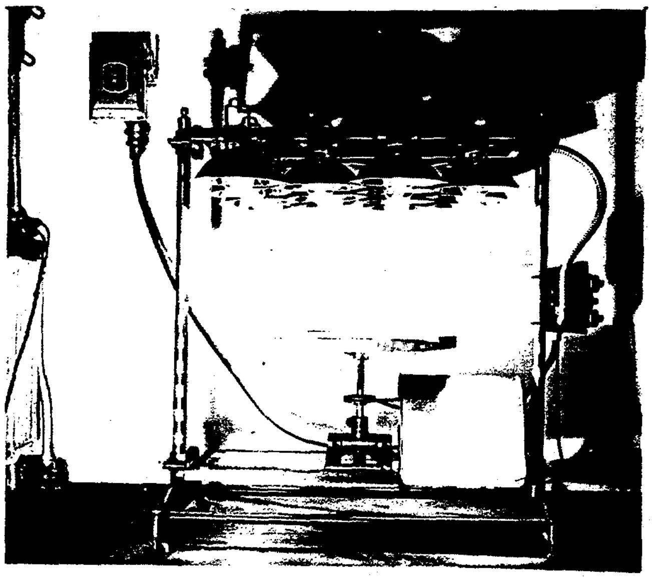
During the year, the laboratory acquired the following new equipment:

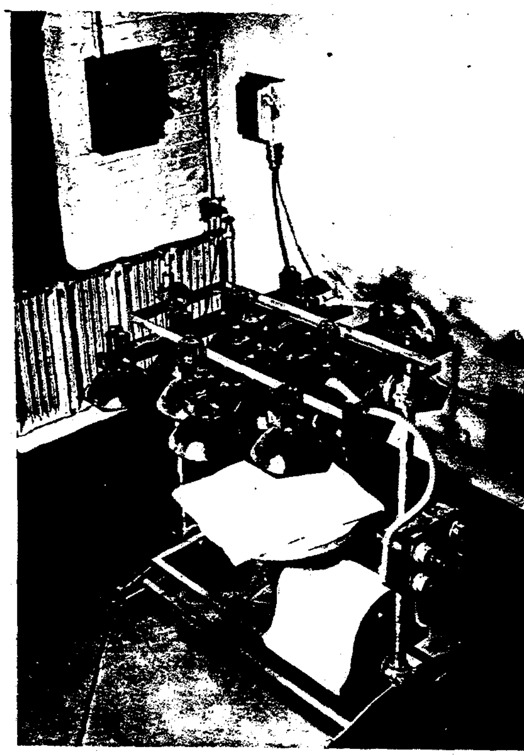
- Infra-Red Baking Unit (cost $214)
- Portable Electrical Temperature Indicator and Accessories (cost $136)
- Conical Mandrel Tester (cost $100)
- Hoffman Scratch Hardness Tester (cost $10)

Of this equipment, the infra-red baking unit was the largest and most costly. It was secured at the request of the Industrial Sales Department, as many industrial paint users have been interested in infra-red heating as a substitute for ovens. Infra-red or radiant heating employs the same principle as the heat lamp used by doctors to "bake out" pain; but instead of one lamp, industrial infra-red equipment uses banks of lamps. Our unit consists of 14 lamps mounted in such a manner that they can be raised or lowered to bring them farther away from or closer to the test panels. These panels are placed on a rotating platform to eliminate shadow effects. The platform will accommodate a testing surface up to 35 square inches in size.

Each lamp has its own reflector which nests snugly against neighboring reflectors, thus preventing the upward escape of heat. The reflectors are gold plated in order to minimize corrosion and dulling by solvent vapors.

Infra-red heating has a definite place in industry but it lacks the magic ascribed to it by over-enthusiastic manufacturers. Our own tests and tests made by others disprove that it has "mysterious penetrating powers" and that it "bakes from the inside out." Infra-red heating does exactly the same thing as any other type of heat. Its main advantages are economy of operation (the lamps need be used only when work is available; an oven has to be operated continuously in order to keep it up to temperature), and flexibility (an oven is usually built to a definite specification and cannot be moved once it is installed; infra-red units can be taken down and readily reassembled anywhere for any type of job).





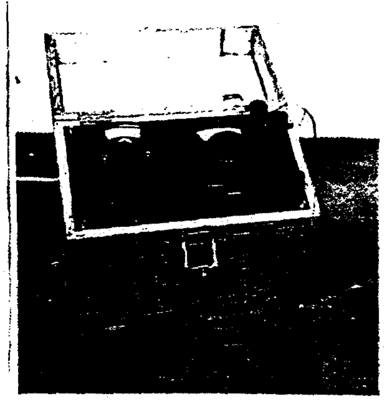
Infra-Red Baking Unit

Front View (above)

Top View (right)

A portable electrical temperature indicator was secured primarily for use with the infra-red unit. An ordinary mercury thermometer measures the temperature of air or of any other medium surrounding the bulb but is incapable of measuring the temperature of a panel. An electrical temperature indicator can accurately measure spot temperature. The indicator is merely a very sensitive voltmeter which records the voltage set up at the tip of the thermocouple used with the instrument. The thermocouple consists of two wires of dissimilar metals, such as iron and copper, welded together at one end. Heat applied at this welded tip creates a minute electrical potential, the magnitude of which varies with the temperature. Temperature can be read directly by substituting a temperature scale for the ordinary electrical scale on the voltmeter.

Because the electrical temperature indicator can be placed at a considerable distance from the thermocouple, the instrument has obvious advantages over a thermometer for measuring temperatures in deep ovens, large kettles, and in other inaccessible places.



Portable Electrical Temperature Indicator

(Wire leads to Thermocouple)

The conical mandrel tester is a modification of the old panel-bending device, but panels are bent over a cone instead of over a rod of uniform diameter. The instrument has been approved by the ASTM and is used by the Bell Telephone Laboratories in evaluating all finishes which we supply to them.

During 1940, our three analytical balances were overhauled and put into excellent repair.

Test Fence

The test fence at Swormville, New York, plays an important part in our annual house paint testing program.

Originally the fence was built at an angle of 45^{o} in the belief that exposure conditions would be accelerated. Angular exposure does accelerate certain types of failure, such as chalking, but it also produces abnormal results, for there is no opportunity to observe normal dirt collection. All important house paint tests are now exposed vertically. This is a cheaper type of construction and is also easier to paint and to observe. We have added certain refinements to our testing procedure, such as the inclusion of sections of copper and iron screening to measure metal staining on white paints and the application of a dark-colored stripe at the bottom of the fence to measure excessive chalking.

Insofar as possible, experimental paints of major importance are exposed on private dwellings. Unfortunately it is difficult to arrange for such tests, as owners are reluctant to use experimental paint even when it is supplied without charge.

The testing of house paints on our test fence and on private dwellings cost about $3,500 during 1941. Over half of this expense went into experimental and laboratory development work. The balance included construction costs, application, land rental, and materials.

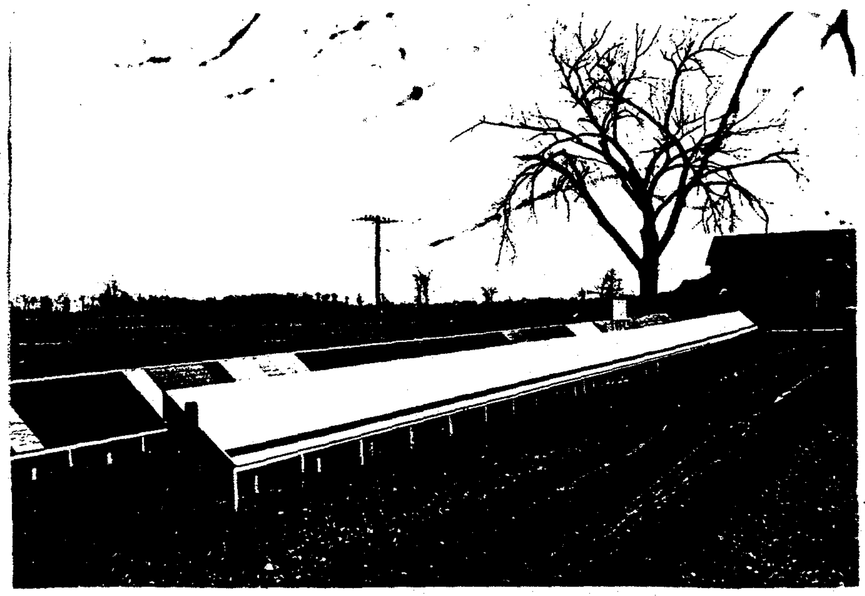
TEST FENCE

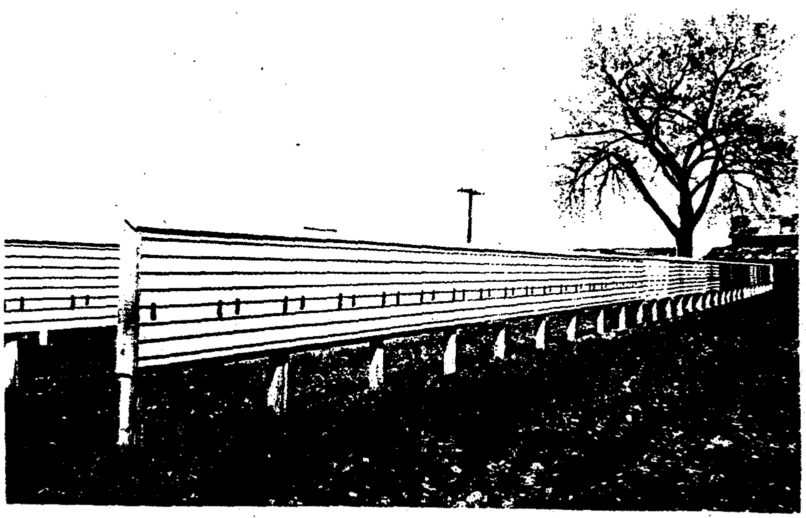
(right)

Original Construction of Swormville Test Fence

—

Note 45^{o} Exposure





(left)
Present Construction of Swormville Test Fence

—

Black spots on fence are sections of copper and iron screening to test staining. There are four fences in this unit, although only two are visible in photograph. Note vertical exposure.

Library

During the past year, all of the books in the library were catalogued and were fitted with pockets and identifying cards in the same manner as public library books. This work was undertaken by Miss Dulmage after studying the system followed by the Grosvenor Reference Library of this city. It is now an easy matter to keep track of borrowed books. Heretofore, books have been only superficially indexed, and while losses of books have been negligible, we never had an accurate record of this investment.

The library has a total of 512 reference books, eleven of which were added in 1941. During the past year, a great many of our older books were reconditioned and rebound. Books without further value to us were given away or were sold to used book dealers where they had resale value.

The library is now organized on a sound scientific basis and should be an even more valuable adjunct to our technical work than it has been in the past.

Complaints

Complaint Record

Year	Total Complaints Received	Percent Justified Complaints	*Complaint Index
1941	175	27	66
1940	248	22	134
1939	264	31	138
1938	239	28	156
1937	276	26	147
1936	315	28	183

*Number of complaints per million gallons of manufactured goods

Fewer complaints were registered in 1941 than in any of the previous six years since complaint data have been tabulated on an annual basis. Complaints have actually decreased during this six-year period. It is possible that the decrease could be credited to factory and laboratory efficiency, but it is more probable that it reflects improved business conditions. Good times seem to be the best defense against complaints, for people are then likely to be less critical.

Laboratory Expense

Laboratory operations cost $123,380 during 1941, an amount higher than that recorded in any previous year since 1929. Costs in 1929 did, however, exceed 1941 costs by a wide margin. While

1941 laboratory costs were 8% higher than they were in 1940, factory production rose 42% and sales 37%. Under the circumstances, increased laboratory expense seems nominal.

The $8,853 gross increase in laboratory operating costs was caused primarily by high labor turnover and the attendant decrease in job efficiency--not by increased personnel or general expense. Specific and justifiable increases in operating expense occurred in three sections of the laboratory. As a result of increased factory production, more raw material and finished product testing was required than formerly. The cost of this work mounted $4,813, or 19%, but raw material shipments increased 42% and the number of factory batches increased 23%. Another major increase in expense occurred in the Paint Laboratory. Here costs rose $2,369, but the Paint Laboratory handled a large part of our raw material substitutions--an activity which did not previously exist. Thus $7,182 or 80% of the increased cost is accounted for by these three activities.

In spite of our high labor costs, the average salary paid to laboratory employees was $1,780 in 1941; the average paid to laboratory employees in the chemical industry is $2,979.

Increased factory production and increased sales lowered our 1941 unit costs very appreciably, as indicated below:

	Cost per Gallon		*Cost per Sales Dollar	
	1941	1940	1941	1940
Sales Problems	1.1¢	2.2¢	.5¢	1.0¢
General Research	1.7	1.8	.8	.8
Product Control**	1.4	1.6	.6	.7
Other Mfg. Services	.5	.6	.3	.3
Total	4.7¢	6.2¢	2.2¢	2.8¢

*Includes paint sales but not subsidiary manufacturing company sales

**Product control cost $1.19 per batch in 1941; $1.66 in 1940

The N.A.M. survey of research budgets completed in 1940 revealed that a typical company spends 2% of its gross sales income for research. The synthetic organic chemical industry spends 3.3% of its gross sales income for research. Pratt & Lambert research amounted to 1.3% (sales problems and general research) of its gross sales income during 1941, or a decrease of one-half per cent from 1940. In spite of the feeling that our research is costing too much, our expenditures are conservative by any of the usual standards of comparison.