INSIDE INLAND

The General Motors Division That Most People Never Knew

William A. Frye

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INTRODUCTION

There are a number of reasons why an insider would want to tell a story about the Inland Manufacturing Division of General Motors Corporation:

1. One can find a few histories of Inland, but they are mostly about the early years and the products, and they don't have much content about the people side of the business.
2. Inland was unique in many ways, both within General Motors and, I believe, compared to other manufacturing companies.
3. Inland people were very entrepreneurial. They were always looking for a new product to make or an improvement in the method used to make an existing product.
4. Most importantly, it was a great place to work. We enjoyed working there. It was always interesting. We were doing challenging work. We whistled while we worked. Many times, we laughed.
5. Inland was very egalitarian. From the General Manager to the guy on the Press Line, the people felt that their particular job was important and that they were making a difference, and that if they had an issue or an idea, it would be heard.
6. Communications at Inland were open and honest.
7. Because many of the important products we made were out of sight, deep in the chassis of cars, and because we didn't have Delco in our name, if you stopped the man on the street and asked him what products Inland Division made, he would probably say "Who??" Or possibly, "The .30 Caliber Carbine!"
8. Inland doesn't exist anymore. Many pieces were sold off, some moved, and some abandoned. The buildings along Abbey Avenue in Dayton, Ohio (except those of the Wright Airplane Company) have been torn down. Inland may be gone, but it should not be forgotten.
9. The people who worked at Inland for a significant number of years, and therefore knew it from the inside, are getting old, and not many of us are left to tell the stories that can explain what made Inland.

MANAGEMENT STYLE

Organizations, and particularly large manufacturing organizations, develop a style of managing themselves that persists over many years and through numerous personnel changes. That style is often, but not always, set by the leadership of the founding managers. 'Style' really isn't a big enough word, it doesn't cover enough. 'The Inland Way' comes closer. The word, and what this story is about, is really the 'soul' of the Inland Manufacturing Division of General Motors Corporation.

THE GENESIS of INLAND

The Dayton Wright Airplane Company was established in 1917 by some leading Dayton, Ohio businessmen and community leaders, Colonel Edward A. Deeds,

Charles F. Kettering, H.E. Talbott, H.E. Talbott Jr., and Orville Wright, in order to make the DeHaviland-4 aircraft for World War I. They produced over 6,000 planes in all. When the war was over, they had an organization, a plant, and employees, all in search of a product.

General Motors bought the Dayton Wright Airplane Company on September 25, 1919, partly to get an entry to the air transportation business, and partly to acquire the services of Charles F. Kettering. Because of a recession that started in 1920, and deepened in 1921 and 1922, its plans for producing peacetime aircraft did not pan out.

Since many of the parts of the aircraft they had manufactured were made of wood, the Chief Engineer, Harvey Geyer, developed a steering wheel made with a laminated wood rim. He and Wallace Whitaker, who at that time was the manufacturing manager, convinced O.E. Hunt, who was the Chief Engineer of Chevrolet, that they could make a safer and ultimately less expensive steering wheel. Finally, J.L. Pratt, the G.M. Vice President and Group Executive, agreed.

In 1922, General Motors divested the Dayton Wright Airplane Company, and on January 6, 1923, the Inland Manufacturing Company was incorporated. That name was chosen so the name would fit whatever product the company could develop.

Dayton Wright had 3 locations: the Knott Building downtown, an assembly plant at Moraine City (which later housed Frigidaire), and a small plant out on West Third Street. The fledging Inland Manufacturing Company couldn't use all that space and chose only to occupy the West Third Street facility. However, by 1927, more floor space was needed, and the plant was tripled in size to 150,000 sq. ft. On November 30, 1936, Inland became a division of General Motors.

Several parts of Inland's 'soul' had been established – an entrepreneurial spirit, an appreciation of the value of all their employees (and a concern for their welfare), and an inventive mindset for developing new products.

A similar thing happened at the end of World War II. Many of the products Inland Division made for that war (including the best-known one, the M1 .30 caliber carbine) quickly disappeared. Rather than just adjust by reducing hourly and salary staff, Inland Division people worked hard on their development of new products and new capabilities in order to try to fill their plant with work. The fact that the Inland Suggestion Plan for years had vigorous participation and many excellent suggestions showed that we had entrepreneurs in all parts of the organization.

THE HISTORY of INLAND'S GENERAL MANAGERS

1923 – Wallace S. Whittaker was the first General Manager of the Inland Manufacturing Company, before General Motors bought it. The company then had 225 employees.
1941 – John D. O'Brien, who had been Production Manager, replaced Mr. Whittaker.
1961 – Leslie C. Wolcott, who had been Director of Engineering at Packard Electric Division, replaced the retiring J.D. O'Brien.

1966 – Thomas O. Mathues, who had been Director of Sales and Engineering, replaced the retiring L.C. Wolcott.
1979 – George Johnston, who had been Works Manager at Delco Remy Division, replaced Tom Mathues, who became a Vice President of General Motors, in charge of the Manufacturing Staff.
1981 – Leonard P. Roberts, who had been General Manager of the Delco Air Conditioning Division, replaced George Johnston.
1983 – John Debbink, who had been General Manager of Delco Moraine Division, and who was then heading up a Corporate Task Force working on combining divisions, added Inland to his responsibilities. Mr. Roberts had died suddenly and unexpectedly.
1984 – Ross M. Haun, who had been General Manager of the Inland Fisher Guide Seat Systems Business Unit, replaced John Debbink. In July of 1984, the former Guide Lamp Division and the former Ternstedt plants of Fisher Body, which produced door trim and other interior trim, were merged to become the Fisher Guide Division. In 1989, the Fisher Guide Division, the Fisher Body plants which produced seat assemblies, and the interior portion of the Inland Division were merged to become the Inland Fisher Guide Division, with its headquarters in the Detroit area. Since there were seat assembly plants located near most of the of the assembly plants, this resulted in the interior portion of Inland having a number of new plants located in other cities, and using Cut and Sew technology, which was quite unlike our prior products. The Chassis portion of the Inland Division became part of Delco Products, located in the Dayton area.
1989 – Rudy Schlais, who had been General Manager of New Departure Hyatt, became the General Manager of Delco Products Division, including the Chassis part of Inland. In 1994, GM consolidated by organizing its separate Component Divisions into the Automotive Components Group, which in 1995 was renamed Delphi Automotive. In 1999 Delphi Automotive became a separate corporation, so parts of the old Inland Division became a part of Delphi Automotive, and other parts became part of another separate company, Inteva Products LLC.

You will notice from the above that only J.D. O'Brien and T.O. Mathues had a decently long tenure as General Manager of Inland – 20 years and 13 years respectively. More importantly, they both "grew up" at Inland. These factors helped each of them to capitalize on Inland's good people and their expertise to grow and improve the Division and its future. The period immediately after Tom Mathues seemed to us insiders rather like a revolving door period of General Managers. I don't believe many of us Inlanders met, or even saw John Debbink. However, Ross Haun did have enough time to be a help and a positive influence. I believe the upper management of General Motors correctly perceived that Inland could get along OK without much help from a General Manager for a few years.

THE HISTORY of INLAND PRODUCTS

Inland was the organic materials Division of General Motors. GM didn't plan it that way, but rather Inland people, looking for products to produce, took advantage of the expertise of their people and their production and laboratory equipment to develop products made of organic materials. However, Inland came in handy when GM thought one of its suppliers was charging too much or was not providing advancements that GM wanted. Inland would be asked to provide a quotation on an existing part or to investigate what improvements we could make. Sometimes we only gave a quotation, other times the query triggered a development project. In most cases, the current supplier corrected their deficiencies, but some cases did result in more sales for us.

Unfortunately, our affiliation with GM gave us a cost handicap. Our hourly people belonged to the United Rubber Workers. When the UAW did their thing by choosing which automaker would be the easiest from which to get agreement for an increase in pay and benefits (that is, Ford or Chrysler or GM), they set an <u>industry</u> pay and benefits package. Sometimes a strike occurred before there was a UAW agreement, and in that case when a settlement was reached, Inland was told to just give our union essentially the UAW package so we wouldn't have a strike and thus lose sales to Ford and Chrysler because of a lack of parts. Thus, our competitors almost always had a lower labor cost.

General Motors encouraged its Vice Presidents to visit the various Component Divisions so they would be more familiar with all of GM's businesses. During my time at Inland there were a number of such visits. The VP's were usually shown the Test Section (where I was usually their guide) and the Laboratories, because that was where we were doing new and interesting things. Most of those men just didn't know what to make of Inland. You could see it in their eyes, and you could tell it from the questions they asked. Most of them came from a primarily metal bending operation, where the UAW (that is the hourly work force) was the enemy, and they would never change the design and/or material of a part every 2 or 3 years, so to them we were a foreign land.

Inland made an astounding number of different products. Following is an Annotated List.

THE EARLY YEARS

An Inland ad which appeared in Fortune Magazine in 1939 provided a convenient summary of Inland automobile products at that time by means of a rendering of a 1939 vintage automobile on which Inland products were highlighted. (See Appendix.) It included:

<u>Steering Wheels</u> (By 1939, these were hard rubber wheels)

Running Boards (A steel insert with rubber molded over it, containing an antenna. We made them for a surprising 25 years.)
Defroster Hose
Windshield Weatherstrips (Started making them in 1933.)
Vent Window Weatherstrips
Rear Quarter Window Weatherstrips
Backlight Weatherstrips
Trunk Weatherstrips
Stabilizer Bar Link Bushings
Front Suspension Jounce Bumpers
Brake Hose
Battery Boxes (Started making them in 1928.)
Engine Mounts (Started making mounts in 1927.)
Accelerator Pedal
Universal Joint Isolator
Grommet Separating Front Bumper Bar from Front Fender
Rear Axle Jounce Bumper
Exhaust Pipe Hanger
Grommet Separating Gasoline Filler Tube from Rear Fender
(Plus another 14 products highlighted but not identified.)
The ad also says "Today, two Inland plants employing over 3600 people, produce more than 425 rubber, metal, plastic and associated products.")
(A second 1939 ad has renderings of a streamlined train, an outboard motorboat, an airplane, a yacht, a bus, and a tractor and it says "Today, Airplanes, Escalators and Streamlined Trains; Automobiles and Tractors; Automatic Refrigerators and Coffee Grinders; Washing Machines and Vacuum Cleaners; Diesel Engines and Outboard Motors – all wear cloaks of Inland-made quiet.")
Ice Trays (Initially molded of gum rubber. We made them for 14 years. We started making anodized aluminum ice trays in 1934)
Tennis Racquet Handles (Made of laminated wood)
Rubber Adhesive Cements for Fisher Body (Started in 1933)

THE WORLD WAR II YEARS

The .30 Caliber Carbine (Inland did not design this lightweight rifle, but it produced by far the largest portion of them. By the end of the war, Inland had made 2,600,000 carbines. If you search a database for "Inland" today (2017), you will get pages and pages of information about the carbines.)
Steering Wheels
Tank Tracks (Rubber and steel shoes, bushings, and assemblies. Inland continued making them after the war.)
Tank Clutches

Gun Sights and Shoulder Rests (For the rapid firing 20 millimeter antiaircraft gun)
Helmet Liners
Aircraft Spark Plug Terminals
Fire Extinguisher Horns
(Plus automotive items from the Early Years list, for use on military vehicles.)

THE GROWTH YEARS – AUTOMOTIVE

Steering Wheels (Continued making them until the end. Details later in this document.)
Clutches
Engine Mounts (Details later in this document.)
Transmission Mounts
Sub Frame Mounts
Body Mounts
Hydraulic Engine Mounts (For transverse mounted engines)
McPherson Strut Mounts
Rubber Suspension Bushings (They provide vibration isolation and are the bearings for front and rear control arms and track bars. We started making them for the second time in 1959. At times, we produced a many as 200,000 a day. Details later)
Rubber Suspension Bumpers (The jounce travel stops)
Propeller Shaft Bushings (Torsional vibration isolation for rear drive cars)
Suspension Ball Joints (Started in 1954. Originally the bearing portions were made of a fabric with a woven-in Teflon surface, impregnated with phenolic resin and molded into a steel socket. The sockets for the later all-steel joints were formed on an automated Hatebur hot forge machine as big as a small house.) (More detail later.)
Hydraulic Brake Hose and the Hose Assemblies (Brake hose was directly covered by a Federal Motor Vehicle Safety Standard, FMVSS No. 106.) (Inland also supplied the brake hose to our competitors who made brake hose assemblies.)
(In November of 1979, a Chevrolet Truck Staff Engineer called our Pat Devincent, who was then our Chief Engineer, Chassis Components, about a problem. At the last minute, they had encountered a No Build interference with their former supplier's brake hose on their revised truck axle. They rushed a new axle to Inland, and within 72 hours, the Brake Hose Team had designed, validated and produced brake hose assemblies to get their assembly line going. To the Chevrolet Truck engineers it was "another Inland Miracle" and they gave the Brake Hose Team a plaque commemorating the occasion.)
Air Conditioning Refrigerant Hose and Hose Assemblies (The increased sales of air conditioning in the 1960's and 1970's highlighted two issues for GM: The high cost of AC components, and high warranty costs because of moisture permeation into the AC system through the AC hoses, causing corrosion in the compressor. Inland was asked to develop and produce AC hose assemblies to solve those problems. Inland

developed a design with rubber compounds in the innertube and the cover which drastically reduced moisture permeation and refrigerant loss, and a less costly spiral wrap of the cord rather than braided cord.)

Brake Lining (Inland purchased the Bondall brake lining company of Rathway, New Jersey in 1939, and with it came Bob Antheil, who was later an Assistant Chief Engineer.)

Rubber Bumper and Door Rub Strips (In the 1973 model year, Cadillac had contracted with a supplier to furnish a bumper rub strip, and the supplier was unable to furnish quality parts. The Cadillac assembly line was starting. By working around the clock over the weekend, the Inland team made the necessary dies and molds and supplied quality parts, consisting of an extruded rubber center section with molded rubber end caps, all mounted to a metal insert.)

Defroster Hose (Details later in this document.)

Drive Axle Boots

Steering Gear Boots

Pillar Post Pads (The pillar posts are the two steel 'posts' that connect the lower body and the roof at each side of the windshield. The Pads were made of urethane plastisol foam with a vinyl skin and were intended to reduce occupant damage in an accident. We had considerable trouble getting them into production.)

Latex Foam Weatherstrips (Considerably more detail later in this document.)

Extruded Sponge Rubber Deck Lid Weatherstrips (Which clipped onto the sheet metal pinch weld.)

Hood Seal Weatherstrips

Extruded Solid Rubber Windshield and Backlight Mounting Strips (These were "Eichner" type strips. To explain: The cross section looked like an H laid on its side. The base (or inner part) of the rubber cross section was 'solid'. The outer (or upper part) had two lips separated by a narrow valley. This allowed the clearance necessary to get the strip in place on the glass and the glass/strip assembly in place on the sheet metal. Then, using a vibrating tool, a 'filler strip' was wedged into the valley, starting in one spot and proceeding all the way around the window, and pushing the lips out and down, and thus clamping both the glass and the sheet metal securely in place.)

Thiokol Glazing Compound (A bulk chemical later used to retain and seal windshields and backlights. We started making it in 1965.)

Thiokol Dam (This was a processing aid at the assembly plants. This little strip was adhered in place on the glass to prevent the black Thiokol from being squeezed out into a visible area.)

Automotive Adhesives and Sealers

Instrument Panel Covers (A large complex molded reinforced plastic carrier and a vacuum formed vinyl skin placed in a mold, and urethane foam injected between them and cured. We started by making a simpler version for Chevrolet in 1956.)

Ash Tray Doors

Glove Box Doors

Polyurethane Foam Seat Pads (We started making them in 1957. In 1969, we installed the world's largest and most automated seat pad manufacturing facility. In the 1970's, we loaded over 100 rail cars per day)
Decorative Plastic Hood and Deck Lid Emblems (These were jewelry!)
Anodized Aluminum Grilles (The 1957 Chevrolet grille was gold and the 1958 Pontiac grille was silver.)
Anodized Aluminum Fender Decorations (That looked like silver.)
Gear Shift and Turn Signal Knobs
Driver Side Inflatable Restraint System (The driver "air bag.") (This development contained the finest engineering work that General Motors ever did. This device is called into action only at the instant the driver is in a serious accident, so it must deploy! It must never deploy when the driver is not in an accident or it may injure him! Considering the design and the materials and the tools and the processes, and everything related to the system, the mindset and the overall goal was not "We want to be sure we do everything right" but rather "We want to make it impossible to do anything wrong." Apparently some of the more recent suppliers of inflatable restraint systems did not have so rigorous a mindset. We used sodium azide as the propellant rather than the less expensive gunpowder because we knew gunpowder could become dangerously fast after a long period, especially in a hot and humid environment.) (See additional information later in this document.)
Endura Front Bumper (This was the nearly indestructible Micro Cellular Urethane front bumper with a special coating, which appeared on the Pontiac GTO. It had a full-depth core. There were ads on television of people whacking the bumper with hammers, crowbars, baseball bats, or sledge hammers. The bumper bounced right back with no dents or even a scratch. In 1968, Motor Trend Magazine awarded Inland their Achievement Award and named the Pontiac GTO "Car of the Year." Paul Haines and Joe Overwein went to Germany to find equipment to produce it.)
Pontiac 1969 "B" Car Bumper Nose Piece (Following the GTO bumper, but less expensive. A two-shot injection molded Thermoplastic Urethane, molded to a steel insert.)
Pontiac 1973 Grand Am Bumper (A five piece bumper molded of Thermoplastic Urethane which was mixed in the injection barrel.)
Corvette 1972 Front Fascia, followed by the 1974 Rear Fascia (These were flexible fascia made of Reaction Injection Molded Urethane, which would withstand minor bumps. They were not nearly as durable as the GTO bumpers.)
Liteflex Suspension Spring (This fiberglass and resin leaf spring has a flex life superior to that of steel springs, will not rust, and is much lighter in weight than steel. It was used on the 1981 Corvette and subsequent models, and still is today. That spring weighed 8 pounds vs. 41 pounds for the steel spring it replaced. In 1981, the Society of Plastics Engineers gave Chevrolet their award for the most innovative use of plastic in an automotive application. In 2001, John Prikkel, a former Inland engineer, bought the business. He is the President of Liteflex LLC. He recruited some additional

Inland engineers, and they continued to produce Corvette springs. As of this writing, they are continuing to develop springs for other customers, primarily truck manufacturers.)

THE INHERITED PRODUCTS in 1989
Seat Assemblies
Door Modules and Trim
Interior Trim
Lighting

THE GROWTH YEARS – NON-AUTOMOTIVE

Anodized Aluminum Ice Trays (More detail later in this document.)
Extruded Solid Rubber Eichner Strips for Railroad Car Windows (The railroads were having a problem – when two trains headed in opposite directions passed on adjacent tracks at high speed, some of the windows were being sucked out. The Eichner type strip solved that problem.)
Extruded Solid Rubber Eichner Strips for Curtain Wall Construction (During the late 1950's, the GM Technical Center was being built. World famous architect Eero Saarinen was responsible for its design, which included curtain walls. The original supplier of the weatherstrips for that kind of construction failed to produce satisfactory strips, and Inland was pressed into service to keep the Tech Center building program on schedule. After the Tech Center was completed, the architect designed our strips into such monumental buildings as the Time-Life Building in New York and the Libby-Owens-Ford Building in Toledo. These were very large strips, made by taking lengths of an extruded rubber cross section and molding onto them square corners, producing a rectangular strip assembly perhaps 10 feet horizontally by 15 feet vertically in its installed position. The size varied by the specific building. The strip was placed around the insulated glass assembly, and that assembly placed on the big steel frame that was fastened to the steel structure of the building, and the 'filler strip' was installed into the strip, clamping the strip onto both the glass and the frame. The glass assembly might be 1 1/2 inches thick and the frame 3/4 inch thick. So when you looked at the skyscraper, it looked as though it was all glass. And it was, except for the black Inland strips that were holding the whole thing together. The upper floors of tall skyscrapers move quite a bit in the wind, and with some prior methods of glazing the glass, occasionally one of those 10 by 15 foot glass assemblies loosened and went sailing down to the pavement. I don't believe there were any deaths attributed to that problem. The Eichner type strips allowed for slight movement but stayed in place and stayed watertight. After three years in the business we had about $300,000 in sales and $70,000 in operating losses, so we sold the business lock, stock, and barrel to one of our competitors.)
Vinyl Magnetic Refrigerator Door Seals

<u>RCA Television Picture Tube Deflector Yoke Insulators</u> (Before liquid crystal type screens.)
<u>Rubber Washing Machine Impellers</u> (For the Frigidaire washing machine with the up and down impeller motion.)
<u>Washing Machine Drive Rollers</u> (Also for Frigidaire.)
<u>Inlyte High Strength Support Floats for the Mohole Project</u> (This project was an attempt to retrieve a sample of the Earth's mantle by drilling a hole through the crust at the Mohorovicic Discontinuity, which lies 11,700 feet deep in the ocean off Guadalupe, Mexico. The drilling had to be done from a drillship, maintained in position within a radius of 600 feet by the ship's thrusters. The great weight of 11,700 feet of drill pipe, and the fact that the pipe was not in a hole, and thus not supported by earth around it, caused problems controlling it. The floats were about 3 feet in diameter and 1 1/2 feet thick, with a hole in the center. They were made in the Inland Government Products Laboratory, of tiny hollow glass bubbles in a high strength resin. The floats were attached to the pipe at intervals as the pipe was lowered, reducing the gravity load on the drilling equipment and stabilizing the string. In 1961, the project managed to drill 5 holes, one of which reached 601 feet below the ocean floor.)
<u>Vibration Control Liners for the Polaris Missile Launch Tube</u> (These were a honeycombed design, molded of urethane, also made in the Government Products Laboratory.)
<u>Invisilift Air Casters</u> (Introduced in 1966, reached their sales peak in 1966, and went out of production in 1966.)

<u>PRODUCTS INLAND DEVELOPED BUT DID NOT PRODUCE</u>

<u>The M-60 Light Machine Gun</u> (This was the famous machine gun that you saw slung over a GIs shoulder in photographs from the war in Vietnam. The GIs called it "the Hog" because they thought the noise it made was similar to a pig grunting, and because it used so much ammunition. In battle, one GI fired the weapon while two other GIs carried ammunition (and a spare barrel) to it. Because of Inland's experience with the M1 carbine, Inland was given the contract to design and develop this weapon. It was a secret project. The engineers worked in a locked room with the windows blacked out, which was just behind the Chief Engineer's office in Building 2. Only a few people at Inland knew about it. Some of the firing tests were made at an abandoned gravel pit. Laboratory tests were made on components of the gun, but the whole gun was not to be seen in public. Secret cold weather tests were conducted in Alaska. After the gun had met all the requirements, Inland was asked to bid on the production contract. That contract required that the production facility be built and an initial quantity of weapons produced, and then just turn out the lights, leave everything in place, and wait for the next order, if any. J.D. O'Brien logically said that we couldn't tie up valuable floor space and have a carrying cost for the facility, with

no guarantee of future business. So Inland did a great engineering job on a product that became famous, a fact that hardly anyone knows.)

Automobile Oil Seals (During two different time periods.)

Automatic Ice Cube Makers (We started making them in 1964, but stiff competition from Whirlpool forced us to sell the business and all its assets to the Gibson Refrigerator Co.)

Air Suspension Bellows (This was the rubber and fabric 'spring' for the 1958 Chevrolet and Pontiac. It was shaped like a toroid with the bottom half cut off. It was an Ed Harris project.)

GM Allison Propeller Regulator Seals

GM Euclid Earth Mover Bearing Seals

Brake Wheel Cylinders Cups and Master Cylinder Cups

Railroad Wheel Roller Bearing Seals

Blow-Molded Gas Tanks

A Rubber Isolated Timing Gear

FACILITY GROWTH MEASUREMENTS

In 1962, well into the growth years, Inland had nearly 8400 employees, and 60 buildings covering 3 1/2 million square feet. The main office building and laboratory facilities were centered on Abby Avenue in the west side of Dayton. The Vandalia facility had 689,307 square feet of plant on a 146 acre tract just east of Dayton's Cox Municipal Airport. It was formerly occupied by the Aeroproducts Division.

PRODUCTION VOLUME INFORMATION

In 1962, Inland produced annually:
More than 7 million steering wheels
300 miles of weatherstrips
Over 7.5 million ice trays
Over 13.5 million ball joints
Over 8.5 million engine mounts
Over 42 million bushings
(Data on our other products not available.)

MANAGEMENT STYLE II

J.D. O'Brien became General Manager of the Inland Division in 1945, so he was there for the tail end of the WWII production and the subsequent period of expansion and developing new products, both automotive and consumer. The pattern of developing new products persisted through the life of Inland. His management methods were years ahead of those of other companies, perhaps because he "grew up"

at the Inland Division. The ideas of being open and honest with all employees, and that the Division needed the ideas and expertise of all employees to be successful, were precursors of the later Product Teams. He practiced "Management by Walking About" long before it became a buzz phrase. You never knew when J.D. might walk into your office and sit down and say, "How are you today?" If you had a picture of your wife or children on your desk he would remark about how pretty or cute or smart they looked. He would say "How is the ________ project coming?", the ________ being one of the latest product or process development efforts. "Is there anything that is preventing you from doing what you are trying to do?" He knew enough about the project to ask specific questions and to understand the answers.

It was a similar conversation whether you were the Chief Engineer or a Production Foreman or a Materials Lab Compounder or a Maintenance Supervisor. My analysis was that he had three purposes: to get better acquainted with a valued employee, to demonstrate that he was personally interested in the particular project, and to insure he was not getting a sugar-coated report through the formal channels. J.D always wore a dark blue suit, and it was almost always so wrinkled that it looked like he had slept in it (which sometimes was exactly what happened). He usually wore a plain red tie. His thinning gray hair was combed straight back, but some of it was usually falling down. The visits were not at all threatening, they were more of a casual visit from a friend who happened to pass by.

When J.D. was walking through the plant, the hourly employees would wave hello to him, and if they appeared to want to talk to him, he would stop and talk for a few minutes.

There is a story that illustrates J.D.'s restrained style: Inland had apprentices in the Tool Room and in the Maintenance trades, and students who were studying Engineering at General Motors Institute (GMI). That group had a committee that periodically held a meeting in the Personnel Conference Room, which was just a few yards from the Ice Tray test room of the Physical Test Section. The Ice Tray room was only about 10 feet by 12 feet, and contained two very large custom made refrigerators, each of which was <u>filled</u> with refrigerated platens. There was a counter with a sink and a filling rack which filled the test ice trays with water to a consistent level, and a machine that engaged the actuating handle of the tray and operated it, displaying the torque required. There was not much space in that room for anyone except the Test Engineer. Max Lewis was that engineer. It was summer, and he got the notion of making some popsicles, so he brought in some Kool-Aid and got Maintenance to cut some short pieces of quarter inch diameter wood dowels for the sticks. This was shortly after I became head of the Physical Test Section. I learned about the popsicles, but ignored it because I thought it was a harmless diversion. The Student-Apprentice Committee also learned about the popsicles, so after one of their meetings, they all traipsed up to the Ice Tray room and squeezed in – about 20 of them, and started harvesting popsicles.

I went up there to tell them to get the popsicles and get on their way, and with perfect timing J.D. came walking up the aisle. He saw what looked like 20 grinning fools packed in the room like sardines, and licking cubical popsicles. J.D. looked a little surprised, but just shook his head slightly and kept on walking. I did not hear <u>one</u> word about the incident, but I told Max to get rid of the popsicles and the dowels and to never make any more.

<u>JOINING INLAND</u>

I joined Inland in June of 1951, so I was there near the beginning of a busy period of development and expansion. My initial experience was an illustration of another piece of Inland's 'soul.' I received a Bachelor's Degree in Mechanical Engineering from Iowa State College. A General Motors representative came to Ames, Iowa to scout out engineers, and he sent my resume to both Delco Remy Division at Anderson, Indiana, and Inland Division. I visited Delco Remy on one day and drove to Inland the next day. I learned at Delco Remy that they were looking for Manufacturing Foremen, and I wanted an engineering job. My interview was conducted in the following manner: I was taken into a large room, in which there was a semicircle of approximately 25 chairs, each occupied by a man in a business suit. I was seated in a chair at the focus of the semicircle, and told that they wanted to ask me some questions. The setting and the questions seemed very adversarial. I remember immediately thinking "I don't want to work here!" The men started firing questions at me. A few were about my education and experience, but most were: "What would you do if ________?" Their primary interest was whether I could function while under pressure. I answered the questions and I didn't get rattled. The escape question finally came: "Why do you want to work at Delco Remy?" I said, "I really want to have an engineering job, so I wouldn't want to work here." I didn't learn much about the products and the organization of Delco Remy.

The next day, at Inland Division, I was taken to Personnel and introduced to the man who handled such matters, Roy Sparks. He asked if I would like some coffee, gave me some literature about employment at General Motors and at Inland, explained their plan for the day, and inquired if I needed any help with transportation to get back home. The interview plan was that Mr. Sparks would take me first to the office of Thomas O. Mathues, who was head of the Physical Test Section at that time, and the person most interested in getting some additional help. During the remainder of the day, I would be taken to the office of the Director of Laboratories (George Rowland), the Chief Engineer (Fred Sampson), the Works Manager (E.E. Bollinger), the Sales Manager (Matt Lause), the Master Mechanic (Howard Walther) (today the term would be Manager of Plant Engineering), and lastly, the General Manager of Inland, John D. O'Brien. Mr. Sparks explained that each of these persons would complete a little report containing whether they would recommend hiring me, for what position, and what they thought my strong points were, and that within 2 weeks,

they would contact me with their decision. All this for a kid fresh out of school and still wet behind the ears.

After the Delco Remy experience, it was like going from the ridiculous to the sublime. Each of the interviewers explained about some of the Inland products and how their particular function fit into the organization. The Physical Test Section was extremely interesting – state of the art test equipment for all the products and for all the materials with which they were made. What was the piece of the Inland 'soul' demonstrated by my interview? Every person in the Inland organization, from the one about to be hired, up to and including the General Manager, is important to the success of the Division. I interviewed at several other companies, but I knew Inland was the right place for me.

There were General Motors divisions at that time whose management style was quite different. You would have to call it management by fear. It permeated their organization, and that practice persisted until 2007. One of those divisions was located in Dayton. If you were talking to a person who had dealings with that organization, and you mentioned that there was a GM division in Dayton that practiced "Management by Fear," he would immediately say "Oh, you mean __________," correctly naming the division.

INTERESTING CHARACTERS

The Inland Division had a number of employees who were interesting characters – enough to generate too many stories to include in this history – but we have room for several of them.

Dale Philippi was the head of the Chemistry Laboratory in the 1950's. His office was right next to mine in Building 2. He was the most gentlemanly, the most conscientious, the most responsible, and the person most knowledgeable about chemistry in the Division. He always wore a white shirt and tie, and a suit. I don't remember <u>ever</u> seeing him when he was not wearing his suit jacket.

In the 1950's, the Chemistry Laboratory advised the other laboratories relative to choosing the chemicals and chemical processes to be used, and the safe handling of chemicals. They conducted tests of chemicals for development purposes, and wrote the specifications for all the chemicals. They also tested samples of incoming lots of chemicals to insure they were correct before they were released for production. The latter purpose generated a large volume of work.

Our offices in Building 2 were small, not more than ten feet square, if that. A desk, a reference table, three chairs and a file cabinet filled up the room. Dale Philippi's office was filled with much more than that! Louie Knab (another character) said it looked like Mt. Ararat. There were jars and cans and cartons and boxes and packages and envelopes piled up several layers deep on every flat surface in the office, including the floor. These hundreds of containers were Dale's reference samples from

the original shipment of each chemical we purchased. Later, if some kind of problem occurred, the suspect material could be tested and analyzed compared to the original material, to try to solve the problem. He kept all that reference material in his office so he would know where to find it, and (amazingly) his system worked. If a certain sample was needed, Dale would say something like "That would be in this corner, the third layer down, near the wall." And pull it out.

Dale used to tell me he wished he could write the material specifications in French, because one can write a much more precise document in French. He took his responsibilities very seriously. He never left his office at quitting time, as a matter of fact it usually was the following morning. He would work until he got so tired he couldn't stay awake – perhaps at 2:30 a.m. – then he crawled up on a hard reference table and went to sleep for a while (in the nearby conference room – his table was full). At perhaps 5:30 a.m. he would go home, shave, put on a clean white shirt and tie, get some breakfast, and be at work again before anyone else had arrived.

In off hours the Plant Protection men made periodic tours of the building and they knew his habits, so if they found him still on the reference table at 6:00AM they would awaken him so he could go home. On one occasion, the first guard couldn't wake him, so he called his supervisor, and they both couldn't wake him, and they thought he was dead, and they were about to call the police when he finally awoke.

His workaholic habits had a downside. On more than one occasion, I have been in a meeting with several other persons and Dale, trying to solve some problem, and he would say, "You know, the most important thing about this is ……" and his voice would trail off and he was asleep. The rest of us, knowing Dale, would just wait, and in five or six seconds, he would awaken and finish the sentence.

Dale did not come to work on Sunday. He went to church instead. He was very religious, and he had the very highest moral standards. He had three female technicians working for him, running the chemical tests on the incoming materials. The rest of us called one of those technicians "The Wolf Gal." Fortunately I don't remember her real name. Al Capp's comic strip about Lil Abner and Dogpatch had a character at that time called the Wolf Gal. Like most of Al Capp's female characters she was quite attractive. She had wild hair but it was beautiful hair. She had a beautiful face but it was somehow rather wild. She had a great body bursting out of her skimpy clothing. That technician actually looked surprisingly like the Wolf Gal! (except for the clothing, because she wore a shop coat). To make matters worse, she was rather aggressive, like the Wolf Gal. Whatever she happened to think came right out of her mouth without any editing. It might be complaining, it might be something risqué, even a dirty joke, or a profanity. She would follow whatever bad thing she said with something like "Don't pay any attention to me, I just feel like hell today – it's the wrong time of the month for me!" In the 1950's, nice girls just didn't say things like that in public. She was also an aggressive flirt.

It really bothered him! Poor straight-laced Dale Phillipi had to try to tame the Wolf Gal! He tried to be very kind and to choose his words carefully, and tell her that

if she talked like that people would think she wasn't a nice girl, and only nice girls get ahead, but she didn't care. She finally either quit or was fired, I don't know which.

For a couple of years, Dale and I ate lunch at a little Mom & Dad restaurant three or four blocks up West Third Street from Inland. Dale ate like he did everything else – precisely. It showed. It wasn't like the military "square meal." But when he cut off a bite or put it in his mouth it was somehow very neat. He didn't talk with his mouth full. He didn't make any crumbs. He didn't slurp his soup. Dale had a little chess board that folded up so that it kept the pieces in place from the last move. So we would play chess for ten or fifteen minutes after we finished lunch. That was Dale's dose of amusement for the day. Dale Phillipi was a major reason why Inland became the organic materials division of General Motors.

Another interesting character was our Chief Engineer, Fred Sampson. My first personal encounter with Fred occurred not many weeks after I started working at Inland in the Test Section. Fred was trying to invent a continuously variable transmission. The heart of the invention was a hollow steel hemisphere, to which was molded a half inch thick rubber surface, mounted on a splined shaft, and another identical part mounted at 90 degrees to the first. Fred was counting on two things that previous similar inventions didn't have. The coefficient of friction between the two rubber surfaces was very high, and the rubber would also yield some, so the contact "footprint" would be significant, perhaps an inch in diameter. Both would increase the torque the transmission could provide.

Fred wanted me to design a test device for his transmission. He wanted to determine how much torque it produced, how easy it was to move the hemispheres relative to each other, and how durable it was. He had already selected the power source, a single cylinder Wisconsin 4-stroke cycle gasoline engine, and regarding the design of the device, he admonished me: "Keep it simple!" I got the specifications of the engine and learned that the piston was 4 or 5 inches in diameter. That is a lot of unbalanced metal going up and down! My design of the test device had a 4 foot by 6 foot steel boilerplate top 2 inches thick, to provide enough mass to counteract the engine's alternating vertical force, with angle iron legs welded to the plate, and with foot pads for lagging it down to the floor. The driven hemisphere shaft was attached to a vane type hydraulic pump. A one foot long arm was attached to the pump case, and the other end of the arm rested on the "table" of a mechanical weighing scale – the kind that the butcher used in those days to weigh your purchase. The fluid coming from the pump went through a needle valve and back to the reservoir of the pump. So, with the engine running, the needle valve could be partially closed, adding load to the transmission. The meat scale measured the torque. The valve could be closed more and more until the transmission started to slip.

I took the design to what we called the Model Shop to be made – the official name was "Experimental Engineering." That group made all the molds and dies with which to make all the prototypes that we tested, and they also made our test fixtures

and similar equipment for the laboratories. The foreman was Jake Handwerker. I can't remember his boss's name. Call him Ted for now. After a day or two, Ted contacted me. He said, "I've had a lot of experience with these kinds of things, and I believe the 2 inch boiler plate table top is overkill, so we are going to change it to 1/2 inch thick boiler plate." I said, "You don't understand! That engine has a very high unbalanced vertical alternating load. The 2 inch thick steel top is simply to provide enough mass to resist that up and down load. Without it, when you start the engine, the whole table will just go walking across the floor." Ted said, "We'll lag it to the floor." I said, "Then it will break the lag bolts and then go walking across the floor." Then he said, "Well, I've talked to Fred about it, and he agrees." Ted was an old buddy of Fred's, so I stopped protesting.

So the device was built, and when the time came to fire it up, there was a crowd to watch. Fred started the engine, and the 1/2 inch boilerplate started bouncing up and down, making a frightful racket. "Ping" went a lag screw, followed quickly by three more lag screws, and the table started walking across the floor. Fred got it stopped. No one said anything for a while. Finally, Ted said: "We'll get the Millwrights to see how they would fix it." The General Foreman of the Millwrights came and looked over the situation. He said, "I think if you got a piece of 2 inch think boilerplate and put on in place of the 1/2 inch top, it will solve the problem." No one said anything.

When the device was fixed and in operation, Fred found that the torque capacity was not as high as he had hoped. If he made the hemispheres larger, and with the requirement of keeping the input and output shafts at 90 degrees, the transmission would become too large to be practical. The white elephant was hauled to Salvage.

Fred Sampson was a tinkerer. He felt he couldn't invent something unless he could make some of the pieces himself. When Engineering moved from Building 2 to the new floors of Building 13, Fred insisted that he have a little workshop attached to his office. In most organizations, the hourly employees of the model shop would cry "foul! – he is doing work that belongs in Experimental Engineering!", and the Union would file a grievance and make a big fuss. But our model shop people understood Fred, so they didn't object, and he got a small lathe, a small drill press, a small end mill and the necessary benches and hand tools in a room attached to his office.

Whitey Deweese did not have unique habits, instead he had a unique skill. He developed the dies with which to produce extruded parts. Dies for solid rubber weatherstrips were the most difficult to develop. I say "develop" because the first try was never even close. Developing extrusion dies was an art, and Whitey was the Artist. A typical die started as a piece of steel about one inch thick and four inches in diameter. The opening through which the rubber was forced was formed by hand, using a number of little files made for that purpose. Every die was definitely three dimensional. The shape of the opening was not the same throughout the one inch thickness, but was usually larger at both the upstream surface and the exit surface, and it was larger by a variable amount around the periphery of the opening. To the

upstream surface were fastened steel fins that gave the thinner parts of the die the strength to resist the load of the rubber being pushed through. Other fins caused the rubber stream to split and part of the rubber to be diverted to another part of the opening before it rejoined. If someone handed you a die and a piece of the weatherstrip which that die made, you would say "I can't believe This thing made That!"

The extrusion department had a very necessary tool - a Comparator. Whitey would put up an enlarged cross section of a new shape to be made on the screen and place over it a piece of vellum. He would sketch the shape that he thought the die should have. That would be the "print" for the first try at a die. He had to take into account the exact rubber compound that would be used. Any solid rubber, even before it is cured, has a lot of "nerve." It is very hard to push it into a different shape. And every compound is different. A sponge rubber compound would have much less "nerve," so the shape of its die would be much closer to the part print. How many times did a die have to be modified before it made the correct shape of the part print? I would guess Whitey would have said "Many!"

Once a shape went into production, the party was not over. A rubber with a lot of "nerve" being forced through the die at very high pressure caused wear. The production operators regularly cut a section and checked it on the Comparator, and when it approached the limit of the tolerance, the die was pulled to be repaired. After several repairs a new die was made.

William Preston Mayfield was not even an Inland employee, but he was an interesting character. He was a famous photographer from the Dayton area. He was born in 1896 and took up photography at the age of 12. In 1910 (at age 13), he started working for the Dayton <u>Journal</u> newspaper. He photographed the Wright Brothers and flew with them, making what is believed to be the first ever aerial photograph, from the Wright B Flyer. He also invented several aerial cameras. He started his own studio in 1912, and he did commercial and industrial photography as well as working for the Dayton <u>Daily News</u>.

At Inland in the 1950's and 1960's, when we needed a first class job of photography done, we called on Bill Mayfield. It might have been for an aerial view of one of our plants, or a new laboratory, or even a new piece of test equipment. The latter was when I saw him in action. When Bill arrived, with an assistant, they would survey the job and plan their attack. They then hauled in a big pile of lights, tripods, reflectors, cameras, and film. At that point, Bill pulled out a big cigar and stuck it in his mouth. He didn't light it. And attack is what they did! – with speed and energy, they set up lights and reflectors and cameras – usually a big wooden 12" by 12" camera with the bellows and the black metal sheet you pulled out to expose the film, and a cable release. They snapped more shots and moved more equipment. I began to notice that the cigar was getting shorter. More shots, more moving equipment. Bill didn't spit and apparently didn't swallow, but the cigar got shorter and shorter. Exactly at the end

of the work session, the cigar was gone, without a trace. I couldn't believe it – he ate the whole thing!

ENGINEERING STRUCTURE

In 1951, the Inland Engineering function was located in Buildings 1 and 2 of the former Wright Airplane Company. Housed there were Product Design Engineers, the Drafting Room, the Engineering Garage, and a group of Engineering Laboratories; the Physical Test Lab, the Rubber Lab, the Chemistry Lab, the Metallurgical Lab, the Brake Lining Lab, the Cement Lab (i.e. adhesives), and the Paint Lab. The Plastics Lab came later, and was located in Building 20, where Steering Wheels were manufactured. These labs were staffed by a mixture of Mechanical and Chemical Engineers, who developed the materials and the processes for their related products. The labs provided the technical support for products and processes in production and were the incubators for the development of new products. They all reported to the Director of Laboratories (George Rowland). In later years, all the labs were moved to Building 13, and the Latex Lab and the Urethane Lab were added.

What did they do? Just as one example, in the 1950's to the 1970's the Rubber Lab had the largest number of engineers, probably 8 or 9. They were called Compounders because they developed the formulae and specified the complete processes for all the rubber compounds, and Inland made every batch, starting with the raw materials. In order to provide all of the desired properties for the specific product – the strength, spring rate, damping coefficient, the processability, the durability, the oil resistance, adhesion to metal, etc. – nearly every Part Number had its own specific compound, developed to meet its own requirements and tests.

The laboratory part of the Rubber Lab was equipped with a tiny Banbury Mixer, just like the big ones, except the mixing chamber was about a three inch cube. It also had a small Rubber Mill, just like the big ones, except the mill rolls were about six inches in diameter rather than 30 inches. It had a supply of all the ingredients needed, various polymers, different kinds of carbon black, curing agents, accelerators, plasticizers, antioxidants, antiozonenants, processing agents, adhesion enhancers, etc. It had curing presses and molds to produce the standard ASTM specimens to measure the various properties, and prototype parts, and a couple of technicians to make them. The Test Section conducted those tests, and then the compounders made additional modifications to improve their formula.

Similarly, each of the other laboratories had equipment specific to their materials, and technicians to operate it, with the exception of the Chemical Laboratory. By the 1960's the Control Lab was handling the testing of incoming materials, and the Chemical Laboratory was headed up by George Rappaport and was equipped with instruments for Infrared Spectroscopy, X-ray Diffraction, X-ray Fluorescence, Gas Chromatography, etc. They performed lots of special analyses to help solve problems,

to find other chemicals to substitute, and for "Benchmarking" or "Reverse Engineering."

It happened that a local hospital had a research program under way to analyze the chemistry of the plaque from the coronary arteries of people who had died of a heart attack and from people of a similar age and weight who died of another cause. They learned about Inland's cutting-edge capability for chemical analysis and asked us to make some analyses as a community service. Inland agreed, so George started regularly receiving little pieces of arteries. I never heard of a report of the hospital's conclusions, but George noticed that certain of the specimens had surprisingly little plaque, and inquired as to their source. It turned that they came from the County Morgue, which did an autopsy on all indigent people, and they knew that those specimens came from alcoholics.

Another story about George: Our brake hose was definitely a safety related product. If it failed, it could cause an accident, so we had a number of controls in place to insure that no out-of-specification hose could escape our plant. When Federal Motor Vehicle Safety Standard No. 106 was issued, we were already in compliance. One of our controls was that every batch of the three rubber compounds used in the hose was tested to insure it was correct. However, the batches were allowed to enter the process before the tests were completed, because we just never had a problem, and our system was such that we could easily quarantine any questionable material.

One batch of the cushion liner compound did not cure properly, it stayed a little gummy, and analysis showed that the accelerator had been left out. So we quarantined the hose that might have used that batch, which was considerably more hose than one batch would make. About half of the quarantined hose was still in 25 foot lengths and half was already cut to length. We set about developing a test or tests to use to sort the abnormal hose from the normal hose. We weren't concerned about the cost of destroying good normal hose, but rather about running behind schedule and shutting down an assembly plant for lack of brake hose. The abnormal hose looked normal, and the cut end looked normal. We tried bending a piece of hose and measuring how quickly it snapped back. That wasn't sensitive enough. We tried applying a radial load to the hose and measuring the deflection. Nothing we could think of was discriminating enough, so we went to George and said, "We need you to make us a solution of chemicals that we can touch to the cut end of the hose and it will turn color if the accelerator is missing." George said "Let me think about it." In just a few minutes, George came back with a small piece of flat glass and a piece of abnormal hose. He rubbed the cut end on the glass and it left a black smudge. Eureka! We got a lot more pieces of glass and more pieces of known abnormal and known normal hose and checked it out thoroughly. It was a perfect test – it was simple, logical, foolproof - no false positives, no false negatives - quick, non-destructive, and inexpensive. From that day, when I have wanted to illustrate what "An Elegant Solution" means, I have used this example. That kind of success wasn't an unusual thing for George; he

frequently came up with a solution that left the rest of us saying "Why didn't I think of that?"

MANAGING THOUSANDS of MATERIALS

Many of the product lines Inland produced were made of a number of different materials. As one example, brake hose had an inner tube, a cushion liner between the two layers of braid, and a cover, each being a quite different rubber compound. Each rubber compound (for use in any product) started with the polymer, that is, natural rubber, or styrene butadiene rubber (SBR), or Neoprene, or butyl and more, each of which came in several possible grades. Carbon black gave the compound its strength and helped determine the modulus of elasticity and the damping coefficient. There were a number of types and grades of carbon black, because the process by which the black was made gave different carbon particle sizes and "structures." For example, if the compound was for an extruded part, the carbon black used would normally be a Channel Black because it made smooth extrusions. If high strength was the major need, a Furnace Black would be used. The vulcanizing agent fastened the long, twisted polymer chains together and gave the rubber strength and stiffness. Sulfur was the most common, but zinc oxide was used for Neoprene and other chemicals were used for butyl. A number of different accelerators speeded up the curing process. The double bond locations in the polymer chain are vulnerable to being cut by oxygen and by ozone, causing cracks. Antioxidants and anti-ozone agents gave rubber parts a longer life. There were other chemicals in each compound for special purposes.

Many of the chemicals mentioned above have long and complex names, and often names similar to other chemicals, requiring extra care to get the correct ingredients into each compound. Inland used the Material Key to address that problem. Each new material that was purchased was assigned the next Material Key Number and its chemical name, supplier, trade name, and location at Inland, etc., all these being listed on one line. As I recall, the Material Key book was about 3/4 inch thick. For it to be useful, the materials had to be listed alphabetically, so the user could determine the correct material key number for the material he wanted to specify or purchase or whatever. That meant that the book was probably out of date the day after it was issued.

Jay Boyer was the secretary for George Rowland, the Director of Laboratories, so it was Jay's duty to type up and issue the Material Key. In the 1950's, the way one got copies of something was with Ditto. A Ditto master was a piece of paper with a sheet behind it which was coated with a purple wax, which transferred to the back of the master when you typed. The master was clamped – at the leading edge only – in the drum of the copy machine. Each time the drum rotated, a sheet of paper was dampened with alcohol and was fed in, and it picked up some of the purple. Jay didn't want to type a 3/4 inch stack of masters every time the Material Key was updated, so he became an artist with a razor blade and Scotch tape. He would cut a master in two,

insert a line, cut a line off the bottom, insert it at the top of the next sheet, etc., etc. You would see him gingerly carry a master that was almost entirely made of Scotch tape, get it clamped in and make copies. I don't know how the master could flip around and around the drum and hold together. I don't know why the alcohol didn't loosen the Scotch tape, or how he got enough copies from the re-used portion of the master.

THE CONTROL LABORATORY

Since the early days, Inland had a Control Laboratory, which was an important part of the Quality organization. One of its main functions was to monitor all the processes to insure that all the critical input characteristics were correct. Mold temperatures, oven temperatures, retort pressures, cure times, cement mixing time, steam pressures, etc., etc. Many of the finished batches of rubber or vinyl or brake lining or other compounded materials were sampled and tested to assure they were OK to move further in the process. In some critical cases, incoming shipments of purchased materials were tested and released or rejected. In the case of Ball Joints, metallurgical tests of components were used to release heat treated batches. All of these kinds of controls were in addition to, and generally upstream of, the controls and dimensional checks made by the Manufacturing Department. The Control Laboratory facilities were strategically located throughout the plants.

ADDING TWO FLOORS to BUILDING 13

When I came to Inland in June of 1951, the Engineering offices were located in Bldg. 2 and part of Bldg. 1. Inland was planning to add two floors to Bldg. 13. The new floors would house some offices, but it would also house many of the Laboratories, and they would have some heavy machinery. Also the desire was to assure that we would be free to make other moves within the building as the future developed. To install reinforced concrete floors like the first and second floors would require moving the current occupants out of the building. Where could we put them? We were adding the two floors because we needed more room. True to Inland's entrepreneurial spirit, we decided to design the addition in-house, and in a way that did not require moving all the building's current occupants.

The guy who was the No. 2 man in Plant Engineering - Charlie Bear - was assigned to lead the effort. Charlie was another interesting Inland character. He was one of those people who just seemed larger than life. He was handsome, with coal black hair. He was a natty dresser. He was very self-assured. Charlie had Bowser-Morner labs take soil cores and test them to assure the old foundation could handle the added weight. He came up with a design for a truss kind of floor for the third and fourth floors, consisting of two layers of 3/4" fir plywood, topped by 2" by 8" wood joists (I believe on 16"centers), in turn topped by another two layers of plywood. Both of the upper and the lower plywood layers had their sheets cross-stacked, so the floor

truss unit was 8 feet by 8 feet by a little under 11" thick. The wood was all to be treated with a flame retardant. Charlie made a sample section of the floor, 16" wide and four feet long, and it was even topped with the dark green linoleum that was planned. We put that floor section in the Baldwin Universal Testing machine in the Test Section, supported at each end, with the load applied at the center of the span, and determined the load required to break it. There was quite a crowd of interested people watching. The load kept going up and up, until the machine groaned, but the sample finally broke with a big CRACK!! – and the crowd cheered. I don't remember the load at failure, but it was clearly strong enough.

I have a copy of the Oct. 22, 1952 <u>Inlander</u>, and the photo of Bldg. 13 already shows the two new floors, so they were installed between June 1951 and October 1952. Unfortunately I did not get to watch the floors installed, so I can't describe the process, and I have not been able to find anyone else who can.

ADDITIONAL INFORMATION ABOUT PRODUCTS

<u>STEERING WHEELS.</u> Only two years after Inland came into existence via the laminated wood steering wheel, the entrepreneurial Inland engineering people were investigating replacing it with an Ebonite wheel, thinking if Ebonite was rugged enough to survive in a bowling ball, it should make a durable steering wheel! (You produce Ebonite by loading natural rubber with lots of sulfur – from 25 to 80 % - and curing it for a long time. That fastens the long flexible polymer chains together in many places, which makes the very flexible rubber very hard and inflexible.) The engineers were not worried about long cure time, thinking it would be a lot quicker for the heat to get to the center of a 3/4" diameter steering wheel rim than to the center of an 8" diameter bowling ball. So Harvey Geyer and his crew got busy building a mold and they told Charlie Nellis, the Factory Manager, that they needed a supply of steam heat with which to cure the wheels. Charlie leased an old steam locomotive and parked it on the rail spur that ran right beside Buildings 1 and 2. He hired a railroad engineer to fire it up every morning and piped the steam in to the press. The engineers found that it still took a long time <u>at</u> temperature to get the Ebonite cured, so Ebonite was too expensive. They didn't give up; rather, they developed a rubber compound containing lots of carbon black and fillers to make it hard enough. Thus the second generation of steering wheels was born, and we made them for over 45 years.

The rubber steering wheels had an "insert" or "spider" made of about 3/8" diameter steel "wire" spokes welded to a screw machined hub, and a circular rim made of about 5/16" diameter "wire" welded to the spokes. The insert was brass plated, which created adhesion to the rubber without the necessity of coating it with cement. Especially shaped, uncured rubber pieces and the insert were placed in the cavity of a steam-heated compression mold and the mold closed to cure the rubber. Our high volume job in the 1950s was the Chevrolet wheels, and as I recall there was a base level and an up level wheel.

Since the rubber still required a rather long cure time, Inland's tooling and maintenance crew developed a machine they called the Gismo. The molding press looked rather normal at ground level, but it actually held two stacks of molds, each going vertically way down underground. If I remember correctly, there were 20 molds going down and 20 molds coming up. The operator loaded the mold that was in the top position, that mold moved down one position, and another mold moved in horizontally from the left to replace it. It was unloaded and reloaded. At the same time the top mold moved in from the left, the bottom mold of the right stack moved horizontally to the left and became the bottom mold in the left stack. The normal non-Gismo process was to close the mold (under considerable pressure) and thus squeeze the rubber to fill the mold cavity, then relieve the pressure, allowing trapped gases to escape, then apply the pressure again, then repeat again. They called it 'bumping', and it was necessary to produce a wheel with a good finish and no cracks or flow lines. The Gismo accomplished the bumping 40 times for each mold. The molded rubber wheels were trimmed of flash and painted in attractive colors, most with a metallic look, and some were two-toned. As I recall, the Gismo was located immediately north of the Doghouse, which was located on the east side of Chester Avenue, immediately north of the railroad tracks.

Cadillacs, Buicks, and Oldsmobiles had plastic steering wheels, starting in 1936. The inserts were similar (they weren't brass plated), but the rims and outer part of the spokes were injection molded with cellulose acetate (in later years cellulose acetate propionate). Inland developed a vapor finishing process to improve on and replace the former buffing operations. Those were the golden years of steering wheel styling! The rims and spokes were slim, in beautiful deep colors, and gleaming smooth. Typically, the wheel assembly had a chrome-plated, die cast horn ring with a beautiful decorative plastic medallion in the center, accented with vacuum metalizing. Some wheels were made with a smooth wire rim that was chrome-plated, and covered with a translucent plastic. They were all jewels!

Chronologically, the next basic style of steering wheel typically had inserts with stamped steel spokes, wire rims, and molded in a soft PVC (polyvinyl chloride i.e. vinyl) of various colors with a grained surface, and horn pads also covered with matching grained PVC. They looked good, but they didn't gleam. The most recent change, starting in 1977, was the move to urethane steering wheels, actually a very dense urethane foam. By this time the horn pads were quite large, because they contained the driver's inflatable restraint. The colors were and are usually dark, so the appearance is rather somber by comparison.

One year Chevrolet made a late decision that, for competitive reasons, they wanted a Corvette steering wheel with an <u>actual</u> wood rim. Déjà vu! Inland engineers quickly designed a set of walnut segments to be cemented together around the rim of the existing steel insert and finished. Jack Strausburg from Purchasing chartered a small plane, and he and Ed Ruff and I went puddle jumping around western Michigan (where a number of furniture manufacturers were located) searching for a supplier for the wood segments. We finally found a company that made wood clothes hangers that could do the job. Once again, Inland successfully solved an "emergency" problem.

We understood that Corvette wanted a steering wheel with a wood rim to make it look sporty, but they and we didn't like the fact that if the wood is broken in a crash, it produces some splinters. So in 1963 Inland developed the SAF-WOOD wheel. A genuine walnut wheel master was constructed and painted with a conductive paint. Then it was electroless nickel plated, which duplicated the pores in the walnut. It was plated until it was thick enough that it could be built into a mold. The plastic used to mold the wheel was a medium brown, and it contained some fine crystalline material, so that the flow lines from the molding operation made it look like the natural variation in the wood grain. The molded wheel was hand rubbed with a dark stain, and the stain concentrated in the pores, just as it does in real wood. A coat of urethane varnish completed the very realistic looking "wood" steering wheel.

If you drove a Cadillac or Oldsmobile in 1971, you might remember the rim-blow steering wheels that Pat Devincent developed and Inland made. They were cellulose acetate propionate wheels with a soft vinyl area on the inside of the rim, almost completely around the 360 degrees, that contained contacts so when you squeezed the rim with your thumb, it blew the horn. The idea was that it was safer (quicker) and more convenient than hunting for the horn button. Besides, it allowed a cleaner, nice looking styling.

ICE TRAYS. When refrigerators began having ice trays, they were made of natural gum rubber. The "tray" was just like a block of light brown rubber with 12 cube shaped cavities with 1/8" rubber walls between them. Inland made those ice trays. They didn't freeze water very fast, they surely weren't attractive looking, and they even gave the ice cubes an exotic taste. To harvest ice cubes, you simply picked up the "tray," held it upside down, and popped out a cube with your thumbs. Inland developed anodized aluminum ice trays, some of which had colored anodizing, with lever operated grids. The lever linkage moved the cross dividers sequentially, one at a time, to minimize the effort required to shuck out the cubes. Both the trays and the grid mechanism were coated with a specially developed resin/wax coating to shed the cubes undamaged (at least when it was new). We made a number of versions with different sizes of cubes, the smallest of which was the Ice Slice, which made cubes almost like crushed ice, and we sold trays to nearly everybody except Frigidaire.

FOAM RUBBER WEATHERSTRIPS. A big development that started in 1953, not too long after I joined Inland, was foam weatherstrips. The seals that prevented water from entering the passenger compartment between the body and the doors had been made of closed cell sponge (i.e. chemically blown) rubber, with a 'skin' of solid rubber about 0.010 inch thick applied. That assembly was fairly stiff, which made it hard to close the door, and also caused the strip to bridge across small steps in the body, such as one piece of sheet metal lapped over another or small wrinkles in the formed metal, which in turn caused water leaks. Also, those weatherstrips were attached with an adhesive, which was a messy and variable operation for an assembly line. So Inland set out to develop an improved weatherstrip. The idea was to make the molded portion out of latex foam, that is, rubber latex that is mechanically whipped into foam and cured in that state. That would provide a much softer strip. The strip would then be coated with a cement type material to make a comparatively thin but very strong skin. (It turned out to be three coats of skin.) The thinner skin would more easily conform to the steps and wrinkles in the body and thus seal better. Molded into the base of the strip was a small wire that zigzagged back and forth, and every five or six inches it was formed into a clip that protruded from the base. The strip would be installed by popping the wire clips into little holes in the door. (A later improvement was a hollow extruded sponge rubber base with little holes every five or six inches to which the latex foam was molded and into which small nylon 'nails' were inserted.) There were lots of late nights and gray hairs. We were working with entirely new materials for us, and inventing new processes, even developing new ways of making the molds. The learning curve was steeper than anyone had anticipated. Our General Manager, J.D. O'Brien, had sold GM upper management on making a huge investment in new equipment and tooling with the promise that we were going to solve the weatherstrip problem (and gain another new product). It looked like we were going to shut down the Fisher Body assembly lines instead. Mr. O'Brien's hair was already gray, and he wasn't the hell-raising type of manager, but you could see the worry on his face, and that concerned everyone. We were making mostly scrap. The landfills didn't want to take the stuff. It would burn too easily, and it would never decompose.

At that time, National Cash Register was still making some cash registers out of wood, and they had a conveyor system that carried wood chips and shavings to their steam boiler, thus getting rid of their scrap and getting useful BTUs. We talked them into making a trial with our latex foam scrap – it contained lots of BTUs. They had a chain they could pull that opened a spot in the roof through which they could see the top of the boiler stack. When our foam hit the boiler, big dark clouds of very black smoke rolled out of the stack. They said essentially, "Absolutely not! Go away and please don't come back!"

Someone at Inland suggested that we ask all of our employees for ideas on how to get rid of the foam scrap. Fiber drums full of foam weatherstrip scrap were placed at every exit from the plant, with an explanation of our problem, and saying, "Take a piece home and see if you can cook up an idea for what to with it." Not many industrial companies would have the honesty and the openness and the faith in their employees to do that!

The problems were resolved in time, and we made millions of foam weatherstrips for years.

<u>SUSPENSION BALL JOINTS</u>. The first suspension ball joints Inland made were for Chevrolet in model year 1957. They had stamped steel sockets with a bearing

material molded into them, that were riveted to the control arms, and their full ball steel studs were fastened to the steering knuckle. The bearing material we used consisted of a woven cotton material with drawn Teflon fibers woven into the top layer, the whole thing being about 3/16" thick, impregnated with phenolic resin and with an adhesive coating on the bottom. The resin didn't wet the Teflon, so the working bearing surface was the Teflon fibers, made very resistant to pressure by being drawn into a fiber. It had two magical properties: it didn't require any lubrication – it worked just fine dry – and it did not have the stick-slip property most materials do, in which the static coefficient of friction is much higher than the moving coefficient of friction. A ball joint that would not require lubrication! Plus better ride! That is what Chevrolet was buying.

As part of the validation process for our ball joints, we designed and built a Ball Joint Wear Test Machine. Since I had the Test Section at that time, I was quite familiar with it. It was made to be geometrically identical to the 1957 Chevrolet front suspension, that is, the upper and lower control arms were each the same orientation and length as the corresponding arm on the vehicle, and the steering knuckle attachments were the same as the knuckle on the vehicle, except that the machine parts were beefed up considerably, and the where the car suspension had rubber bushings, the machine had beefy ball bearings. The regular big coil springs from the car were used on the machine. There were two suspensions on the machine, side by side. Each of the two knuckles was actuated up and down by a connecting rod attached to a crankshaft that had two large flywheels. The crankshaft was driven by an electric gear motor. In addition, the knuckles were "steered" by a mechanism too complex to describe here. The two suspensions were out of phase by 180 degrees – when one was at the bottom, the other was at the top. Each went from full jounce to full rebound 60 times a minute. The steering cycle was from left stop to right stop in 10 seconds. Thus the test was considerably more severe than any test that could be done on the car.

Overall, the machine was about 7 feet tall, 9 feet wide, and 3 feet deep. It was rather fearsome at rest and quite fearsome in action. We built a cage around it to prevent someone from stumbling into it and being masticated. We took initial wear measurements on a set of dry ball joints (no grease) and started a test. After three days, we removed and measured the ball joints – zero wear. Reinstalled them, ran a week – no wear. Another week – no wear. Also, the joints did not heat up from all that moving. Thinking they might perform worse if they were greased, we ran the same tests over again with greased joints – again, no wear.

Unfortunately, because of the design of the front suspension, (which was new for 1957), there was not sufficient room for properly designed rubber seals, that were supposed to keep out the water and dirt. (The production seal lips <u>slid</u> back and forth on the domed stamping.) The Teflon fiber couldn't overcome both the corrosion and grit that leaked in, and the occasional greasing didn't fully flush them out – so the magic ball joints ended up performing no better than ball joints with no Teflon fiber.

<u>RUBBER SUSPENSION BUSHINGS</u>. Suspension bushings deserve a little more explanation. For one reason, although they were small parts, they performed several tough functions. They supported part of the weight of the vehicle (even when it wasn't moving), they helped isolate the shock of bumps and pot holes, they carried part of the loads of acceleration and braking and cornering, and they were like bearings with very little "friction." A second reason is that the processing was difficult and unique. When Inland got into developing and producing suspension bushings for the second time – for the 1955 Chevrolet – suspensions were more sophisticated than in the past and therefore so were the bushings. The inner steel tube and the outer steel shell were coated with zinc dichromate for corrosion resistance and for adhesion. The outer shell had a flange so the rubber could have a head to resist loads axial to the bushing. The engineer on the job was Jim Fredrick, and he had to develop both the design and the process, which he did with care and great diligence. Some detail is needed here to explain the problems. To assemble a bushing, the steel parts were put in a fixture, a bullet nose put in the inner tube, a funnel put over the outer shell, the rubber bushing was dipped in a lubricant, which actually was a chlorinated rubber cement, and placed in the funnel and WHAM! The ram on a high speed air cylinder shot the rubber between the steel parts very fast so the cement would not all be wiped off before it got into place. The rubber part was dramatically shorter and fatter than the space between the steel parts, so the rubber was compressed dramatically in the radial direction. This caused the radial spring rate of the bushing to be dramatically higher and the torsional spring rate to be dramatically lower, and those in turn caused the durability to be much greater. The chlorinated rubber cement reacted with the zinc dichromate to produce adhesion to the steel parts, further improving durability.

The detailed shape of the rubber part had to be exactly right or the position of the steel parts would be wrong and highly variable. Jim Frederick had to make a number of trials before he developed the "equal drag" patented shape which worked. He had a corner of the Model Shop with an assembly machine, fixtures, parts, and cement. The Model Shop hourly employees understood that Jim was not making prototype parts, but rather was developing a process, so they didn't complain that he was doing their work.

The production assembly machines had the form of turntables, and there were dozens of them in the department. That department was rather loud with the WHAM!s of dozens of machines, and rather heavy with the odor of the toluene solvent in the cement.

<u>DEFROSTER HOSE</u>. One of the things that impressed me about Inland the first time I walked through the various manufacturing departments, and for many years more, was the smells generated by those organic materials that were being made into products. I don't want to call them odors, because that term infers something unpleasant, and most of them were very pleasant. The very aromatic benzene, the heavy scent of toluene, the many varieties of other hydrocarbon solvents, natural

rubber, Neoprene, styrene butadiene, butyl, polystyrene, acrylonitrile, urethane foam, the phenolic resin in the brake lining, methyl ethyl ketone (lacquer thinner), cellulose acetate propionate, the wax on the urethane foam molds, lubricating oils, the various adhesive cements, (each of which was a combination of polymers and solvents), latex foam, etc. Going for a walk at Inland was the industrial equivalent of a walk in a flower garden – a potpourri of scents! Your nose never got bored.

There was however, <u>one</u> unpleasant odor. Inland made defroster hose for a while. The department was set up in the basement (also known as the ground floor) of Building 13, the office building. The equipment was a cross head extruder, a small steam retort, a large number of cylindrical sheet metal mandrels about 3 inches in diameter and 20 feet long, and trucks to hold them. The mandrels were held on centers at 90 degrees to the extruder and rotated and slowly advanced past the extruder head. Thus a half inch wide stream of unvulcanized rubber, with a small diameter steel wire embedded in it, was laid down on the mandrel in a spiral, with about a 1/8 inch overlap. The covered mandrels were placed on a truck that held 25 mandrels at a time and was on rails that ran into the retort. The retort was closed and charged with steam, and the hose was given a long cure in high-pressure direct steam. The hose was then blown off the mandrels with air. The combination of the steam and the particular rubber compound produced an odor that was unpleasant, but it was hard to describe to someone.

Whenever someone in Building 13 wanted to go from the building to a location in the eastern portion of the plant, they would take the elevator down to the basement. Also, if they wanted to go to a vending machine area, it was west of the elevator in the basement, and the elevator was squarely in front of the defroster hose area. When the door opened in the basement, the odor hit you right in the face. At that time, the Test Section was located directly above the defroster hose area on the first floor. Mark Deal was one of our longest serving test operators, and he was another character. He named the odor. He said "It smells like a Hindu gym shoe."

<u>THE GM CLIMATE for INNOVATION</u>

In the 1960's and 1970's, and even into some of the 1980's, the GM Car Divisions were relatively independent. They even competed with each other to bring out new features. Pontiac was the most successful at that - remember the slogan "Pontiac Builds Excitement!"?

In an effort to reduce costs, General Motors moved much of forward planning and development to the corporate level, so more new ideas were considered and rejected before the idea reached the Car Division level.

For one example, Paul Haines worked for General Motors Advance Technology Vehicles at the GM Technical Center on the "Precept" vehicle from 1995 to 2001, employed as an individual, not as an Inlander. Never heard of it? Not many people did. There was a joint Auto Industry-Federal Government Partnership for a New

Generation of Vehicles. The challenge was to design a five-passenger sedan that would get 80 miles per gallon of gasoline. To achieve that difficult objective, engineers had to re-think every single aspect of the car to save weight and energy – even small things like dome lights, rear view mirrors, gages, knobs, dials, switches, etc. etc. The resulting GM vehicle was introduced at the 2000 North American International Auto Show in Detroit, and it was the only vehicle to reach the 80 mpg goal. Also, GM was awarded first place in the Auto Interiors 2001 Design & Technology Awards for the design of the vehicle's interior space. After the awards, the questions about how much the public will pay for that kind of a car prevailed, and no such production vehicle was built, and the Precept faded away. Inland itself had no part in and no special interest in that development.

Inland retained its innovative approach, but in the 1990's and beyond, innovations were harder to sell.

THE EFFECT of FEDERAL MOTOR VEHICLE SAFETY STANDARDS (FMVSS) on INLAND PRODUCTS

Government crash safety regulations were proposed in the early 1960's and started becoming effective in the late 1960's. Among these were standards which specified dynamic performance requirements based on a simulated occupant (i.e. test dummy) crash interaction with the vehicle interior. These regulations were phased in over time, and they affected Inland's interior products and test systems in multiple stages.

Early Stage: Initial standards covered component tests, requiring dynamic laboratory testing to demonstrate performance with a lap-belted occupant. Inland's customers expected Inland to handle the component development activity necessary to meet these new standards:

- **Instrument Panel Pads (Drove major IP design changes from painted metal structures to reinforced plastic structures clad with foam and vinyl.)**
- **Steering Wheel and Steering Column Torso Impact Tests (Required design changes to steering wheel inserts to provide the dynamic strength and load deflection characteristics.)**

Interim Stage: Subsequent standards proposals involved protecting non-belted occupants in frontal car crashes. While Inland's customers were responsible for meeting these new requirements at the vehicle level, they expected Inland to design and develop the interior components to support their efforts.

In the early 1960's, these requirements led Inland to acquire a pneumatically powered forward acting crash test sled, a first for a Component Division. This sled

propelled a car body with test dummies and development components forward and into a shock absorber, which simulated a frontal crash. The shock absorber was programmable so it could duplicate the deceleration profile of a particular vehicle in a crash, for example 30 mph to 0 mph in 2 or 3 feet.

Inland engineers worked with customers and suppliers to develop the energy management components. These included;

- **Instrument panel and mounting structure designs that provided lower torso support for the driver, and support surfaces and structure for the passenger airbag, which was supplied at that time by Fisher Body.**
- **Steering wheel designs which integrated airbags into the steering wheel for driver torso protection.**
- **Development of safe and reliable airbag inflators and designs, along with a supplier base to fabricate them.**
- **Electro-mechanical crash sensors.**

The forward acting sled had some limitations:

- **Because the sled had to be first accelerated to speed in a short distance, the test dummy tended to be jostled out of the correct position before impact. Test repeatability was a problem.**
- **Testing with a single dummy added to the number of tests if there was a need to also test the interior for passenger side performance.**
- **After each test, the test dummy had to be inspected for damage and adjusted or calibrated before it could be used again.**
- **There were over 24 channels of data (crash forces and accelerations) that had to be collected during the test for post-test analysis. The ability to collect the high frequency signals from the numerous transducers was laborious. The data was captured using tape recorders and then played back at a greatly reduced speed to a computer system for calculations and analysis of the results. This would typically take 8 to 16 hours.**
- **There were up to 7 high-speed cameras (500 to 1,000 frames per second) used to capture the kinematic actions of the dummy and the interior components for post-test analysis. This would normally be an overnight activity.**
- **The time between tests was controlled by the time required to process and analyze the test and film data, then fabricate the changed test components, install the new components, and prepare the sled for the next test. This could take as little as one day and as long as a week, depending on what might need to be changed.**

Although this development work started in the late 1960's, the state of crash detection sensors and airbag inflators was not advanced enough to meet the performance and extreme reliability needed for the proposed standards, based on unbelted occupants, to be feasible.

In 1972, GM built one thousand 1973 Chevrolet Impalas with airbags. They were all painted green. They were put into use in selected companies where they could

be tracked and monitored, and the details of any crashes recorded and analyzed. Inland supplied the driver airbags, steering wheels, knee restraints, and instrument panels for that build.

After negotiations with the regulators, and to measure public interest in passive restraints, General Motors ran a production demonstration program of airbag-equipped Buick, Oldsmobile, and Cadillac large cars, in 1974, 1975, and 1976. GM anticipated selling 100,000 cars with airbag systems. Inland supplied the driver airbags, steering wheels, and instrument panels. Only approximately 10,000 such cars were sold.

Later Stages: The unbelted performance standards continued to be the goal of the regulators. The problems included lack of reliable crash sensing as well as the large heavy inflator designs included in the early program.

As automotive electronics and inflators were improved, new requirement dates in the late 1980's were proposed by the regulators for passenger cars. These proposals however did set the base requirements with the seatbelts in use, and had just a few requirements in an unbelted configuration.

Inland again was working with customers and suppliers to develop systems to meet the new requirements. In the earlier programs, Inland supplied modules for the driver side using pyrotechnic inflators. The passenger side modules had been powered by compressed gas, and they were developed and supplied by the Fisher Body Division of GM. These modules were mounted in the lower part of the dash and had a large airbag in order to cover both the middle seating position as well as the outboard seating position. By this time the Fisher Body Division had been divided up and moved into other divisions. The new programs were using a smaller airbag, covering only the outboard passenger, which could be mounted in the upper area of the instrument panel.

Our customers wanted steering wheel air bag modules which were smaller and lighter and which had improved styling flexibility and materials. They also wanted passenger air bag modules which could be mounted under the instrument panel surface and which would deploy through the panel surface. In both cases, the areas where the air bags came through the styling surface had to be unobtrusive for normal daily non-crash use.

With Inland now being responsible for a number of driver and passenger air bag programs, and for the testing to show compliance with Federal Motor Vehicle Safety Standard No. 201, Occupant Protection in Interior Impact, it became obvious that Inland needed increased impact test capability. Therefore in the late 1980's Inland acquired a larger, rearward acting, pneumatically powered impact sled to support not only in-house development activities, but also customer (Car Division) program support. Rather than to accelerate the test body forward and then crash it into a barrier, this sled accelerated the test body to the rear at a controlled rate, simulating the specified crash. This new facility had these improved capabilities:

- Simulation of heavier vehicles and vehicles with "stiffer" crash pulses. Payload weight capacity was doubled to 5,000 pounds and speeds up to 55 mph.
- Driver and passenger airbag systems could be tested at the same time.
- Test dummies could be more accurately positioned.
- Enough dummies so repair and calibration could be done while testing was proceeding.
- Seventeen high-speed cameras with speed of over 1,000 frames per second.

Impact Sled is a simple term, but it means a quite large and complex installation, including a long track for acceleration and deceleration, large compressors and tanks and valves to provide the air to move the test body, high speed cameras, anthropomorphic dummies with accelerometers in their heads and force transducers in their necks and chests and legs, miles of cables to carry the data, and large computers to analyze the data. There are horns and flashing lights and other safety measures for the test crew, a protected observation room, and a missile type countdown. It still takes days to set up a test, a few seconds to make the test, and hours to summarize and report the results.

Inland conducted a number of these tests for the GM car divisions. FMVSS No. 201 specifies a maximum Head Injury Criteria, calculated from the acceleration and time measurements, a maximum Chest Deflection, a maximum Axial Force in the upper leg, a maximum Shear Force and Bending Moment in the upper neck, and maximum Tension and Compression Forces in the upper neck.

At the time that this improved sled was installed, Inland was a part of Delphi. This sled, and a similar facility installed at Delphi's German Engineering facility, were used to demonstrate Delphi's capability as an independent supplier.

PRODUCT TEAMS

Because Tom Mathues helped to create, and then inherited, an organization that was open, and honest and entrepreneurial, where each employee's contribution was appreciated, he was able to promote the Product Team organization, which in turn made it possible for Inland to effectively improve on existing products, and to develop and produce new products (some of which won industry prizes), in production volumes. We had a sales promotion phrase that said it all – "Inland, where Imagination and Performance are Partners." I believe that Tom Mathues was the author of that phrase.

Here is a brief explanation of Product Teams: A Product Team was formed to handle a product line. For example, the Mounting Units team would cover engine and transmission mounts, body mounts, McPherson strut mounts, suspension bushings, and suspension bumpers, all of which were made of rubber and metal and were used to control noise and vibration. Team Members would include Product Design Engineers, Rubber Compounders, Tool Engineers, Process Engineers, Sales Representatives, Purchasing Buyers, Financial Representatives, and Manufacturing Managers. The Chairmanship of the team rotated every four months, from Product Engineering to Production Engineering to Manufacturing, etc., the time of the year depending on the product. The team met at a frequency they determined and they managed those product lines, set their own budget, paid "dividends," and made investments in equipment.

The top managers of the Division – the General Managers Staff – acted as a Board of Directors. Each Product Team made a quarterly presentation to the "Board of Directors" at which they gave a "State of the Business" presentation, reported on new developments, made proposals for capital investments, and reviewed any major problems with which they had been dealing.

There were a number of advantages to the Product Team system: 1) If some problem occurred, all the members learned about it quickly, perhaps at a regular meeting, and at the same time, so the focus was <u>not</u> automatically on whose fault it was, but on how can we <u>fix</u> it, and usually fixing it would require action by several members. There was none of the "I don't care about <u>your</u> problems" syndrome. 2) The members were highly motivated – it was their business, and they wanted to make it great! 3) Even the newest employee got a chance for the General Manager's Staff to meet him and see him perform, something that might take years in some organizations. 4) The teams quickly took advantage of the Brainstorming Factor – ideas flying around in a group generate more ideas, and one of those new ideas may be the magic one.

<u>INLAND IS ITS PEOPLE</u>

In 1985, Inland personnel people put together information available from Wage Surveys, Annual Reports, Inland Data, and General Motors Data, and created a presentation titled "Inland <u>Is</u> Its People" (underline added). The title itself reflects the Inland attitude toward its people. The stated purpose of the presentation was to answer the questions:

Who are we Inland People?

How have we changed?

How do we compare with employees in other companies?

Data from several of the charts in the presentation are shown here:

No. of Employees	Average Age	Avg. Length of Service	GM Avg. Length of Service
2489	43.7	19.01 years	15.0 years

Percent of Women in the Workforce

	Inland	GM	Ford
Hourly	59.7	17.5	9.2
Salaried	20.2	24.0	19.6
Total	51.4	19.0	13.0

Percent of College Graduates in Workforce

Inland	General Motors
47.0	39.0

Inland vs. US Average Salaries

	Inland	US
Non-Exempt	$34,000	$17,000
Exempt	$45,000	$30,000

Inland vs. General Motors Salaries

Salary Level	Inland	General Motors
4	$29,712	$28,380
5	$33,780	$33,829
6	$40,080	$39,156
7	$47,832	$46,440
8	$57,888	$55,896

The conclusions stated in the presentation were: "Inland has a diverse, well-educated and experienced work force" and "Inland has a well-compensated work force, which has salaries competitive with the top companies in the U.S."

In addition, I believe the data show that:

Inland people had a greater loyalty to their company than GM employees in general. The larger percentage of women at Inland reflects a greater number of light assembly jobs. The larger percentage of college graduates was required to engineer and process a more diverse product line, using more diverse materials, and more products that were re-engineered every few years.

THE ROLE of the TOOL ROOM and MAINTENANCE

One of the unique strengths Inland had in the 1950's and 1960's was people with a lot of expertise and a strong team ethic in the Tool Room and the Maintenance Departments. They also had the entrepreneurial spirit and the inventive mindset of the rest of the organization. The Tool Room equipped itself with such things as a planer long enough to cut the long foam weatherstrip aluminum molds and with an electroless nickel plating facility to make steering wheel and horn pad grained molds. Actual maintenance (lubrication, cleaning, and preventative replacements) was the lesser of the things that the Maintenance Department did. There were quite a few repairs needed, but installation of equipment was the biggest and the most important function. Inland had its own steam plant, and miles of steam lines to supply heat to the hundreds of molding presses, big steam retorts, steam ovens, and other equipment, and we also had a number of air compressors.

New installations kept the Plumbers and Electricians and Millwrights busy. The Millwrights prepared the site for the installation of new heavy equipment and moved it into place and lagged it down. When there was an outage of a piece of equipment, it usually was the Millwrights that had to fix it – in a hurry.

In 1951, the scope of the products Inland was making was small enough that the Engineering Laboratories could provide enough technical support to the Tool Room and Maintenance to get new processes installed. However, as Inland grew, and the number of materials and products and processes multiplied, it became clear that we needed full-time Tool Engineers and Process Design Engineers and Production Engineers in the Manufacturing organization. The major reason is that our processes were never static. We almost never made the exact same product year after year. For example, a Chevrolet Impala front engine mount might be a relatively simple rubber/metal sandwich one year and a hydraulic engine mount the next year, requiring an additional new process. A change from a foam weatherstrip to an extruded sponge weatherstrip on the same car door entails entirely different tools and processes. A change from a rubber steering wheel to plastic, or plastic to vinyl, or vinyl to urethane, each require a different process. Since we did so much reinventing, the Tool Engineers and Process Design Engineers and Production Engineers had to be entrepreneurial and inventive and open and communicative to be effective. Given our kinds of products and materials, the Product Teams were destined to form.

EXTRA-WORKPLACE ACTIVITIES

Apprentice/Student Banquet. Inland held an annual dinner to celebrate the graduation of that year's class of the Apprentices and GMI students. To top off their education, the class, as a group, conceived, designed, and produced a small memento to be given to each of the attendees at the dinner, using some combination of Inland technologies. They also designed and made all the necessary tools – molds, blank dies, form dies, masks, fixtures, etc., staying within a budgeted expense. Some examples of mementos were: a decorative plastic letter opener; an ash tray with a molded and painted hard rubber base and a formed and anodized aluminum tray with cigarette rests; a no-spill plastic snack dish with an upturned periphery and a depression in the center to hold a matching plastic tumbler, molded in several colors and with a gold painted rim; an aluminum serving dish spin-formed and anodized and died blue or gold; durable molded rubber automobile floor mats; and a stadium cushion, consisting of a vinyl skin heat sealed around a foam core.

Inland Children's Chorus. A popular tradition that Inland sponsored was the Inland Children's Chorus. Active from 1936 to 1970, the Chorus gave the 8 to 16 year old children of employees a musical education and gave the community high quality entertainment, with concerts during the year and a special concert at Christmas. Attending it was a must for Inland families, and highly enjoyed. The girls wore identical long dresses with white collars and cuffs. The boys wore identical dark shirts that looked more like Eisenhower jackets, and trousers. Many of those children later

became Inland employees. "Graduates" of the group still maintain a web site with more information at www.InlandChorus.com.

Management Conferences. In the growth years, Inland Division held a three-day offsite Management Conference about every three years, attended by Exempt employees and higher. Earlier conferences were held at Indian Lake, in Ohio, with later conferences at the French Lick Sheraton in Indiana. The business part of the conference consisted of presentations covering the State of the Division, where we were relative to our goals, and future goals and plans. The reward part consisted of golf, swimming, skeet shooting, horseback riding and fancy dinners with door prizes.

Length of Service Picnic. In the growth years, Inland held an annual picnic at the Inland Activities Center, the purpose of which was to recognize all of the employees who had completed 25 years of service, or 35 years or 40 years. There were hourly "door prizes," and the inductees received a gift. (I still have my watch.) Eating of picnic fare and drinking of picnic beverages was essentially continuous, and the employees had fun greeting each other and catching up on what had happened in their respective families.

The Inlander. The Division "newspaper" reported on such things as retirements; new products; Suggestion Plan winners; the 25, 35, and 40 year Picnics; employee promotions; employee hobbies; Vice President visits, bowling scores; etc., etc.

Inland-Sponsored Sports. In the early years Inland was a significant force in the Dayton area for baseball (hardball) activities. It is said that many people were hired for their baseball abilities. Inland was a family type organization, and took great pride in supporting employee sporting activities over the years. A section for Recreational Activities was established in the Personnel Department to provide that support.
In the 1950's, Inland was a sponsor of several teams in the high school summer baseball league.
In the 1950's and 1960's Inland had a Departmental league of 8 to 10 Softball teams, and a softball team participating in the local DIAA league with teams from NCR, Armco, the other GM divisions and Wright-Patterson Air Force Base.
Inland sponsored an AAU Basketball team playing at the Fairgrounds Coliseum against National AAU teams, Departmental Basketball teams that played at local schools, and another team that played in the Industrial Recreation Athletic Division at Bomberger Park.
Inland sponsored a DIAA Bowling team that played against other GM divisions and other local companies, and a Departmental Bowling league.
Inland also sponsored tennis and volleyball teams that played in the DIAA leagues.
Inland willingly provided most of the facilities, equipment, uniforms, shoes, officials, fees and many more items to enable its employees to engage in these activities.

As Arnold L. Meier put it, "During my years at Inland, I grew to recognize the wisdom they had in supporting these activities. The participation allowed people to develop a knowledge, friendship, and understanding of each other. In later years as problems arose in the development and production of products, this experience allowed faster resolution of these items."

MISCELLANEA

Heavy Equipment. **Inland had quite a few rubber mills at various locations in the plants. A mill typically had two steel rolls about 30 inches in diameter and 9 feet long, mounted at the same height. The rolls were geared together so the back roll turned one-third faster than the front roll, forming a high shear area in the nip to thoroughly mix the solid materials. Water circulated in the rolls to control their temperature. The nip between the rolls was adjustable, down to zero. Along with the frame and the drive motor, it was a heavy piece of equipment. Some compounds were mixed entirely on a mill, and some were mixed in a Banbury, a powerful internal kneading machine, and then dropped onto a mill for sheeting off into pieces a person could lift. Watching an operator mix a several hundred pound batch of rubber on a mill was watching an industrial ballet full of skill and strength.**

Have you ever seen an electric motor that was 15 feet in diameter and 1.5 feet long? Inland had one in the rubber mixing department. The stator had a large number of field coils, perhaps 24. The rotor took about 5 or 6 seconds to make one revolution. I believe it powered a Banbury. We had rows and rows of molding presses. So the Millwrights had lots of big, heavy equipment to install or repair.

Firemen. **Inland Division had employees who were full time Firemen. They regularly inspected all areas of the plant to prevent and help correct potential fire hazards, and they checked the fire extinguishers located around the plant and recharged them as necessary. There were small "fire trucks" at strategic spots in the plants, for use on a larger fire. When one of the welders from Maintenance went into the plant to do a job, a Fireman and his equipment went with him, just in case a spark or a flame might start a fire. We had very large pieces of equipment that dipped metal inserts into large tanks of liquid cements (made with petroleum solvents) and dried them. The foam weatherstrips went through very large pieces of equipment that flowed-on the flexible skin that gave them their strength – three different layers – also made with petroleum solvents. When you consider the large quantities of hydrocarbon solvents, the latex foam, the urethane foam, plus all the other organic materials we had at numerous locations in the plant, you can understand the emphasis on fire prevention. A fire in any one of those locations would have been spectacular!**

The Doghouse. **In the 1950's, Inland had a facility that the people called the Doghouse, not from the "being in trouble" idea, but rather because it was very small.**

Most of the area in the building on the west side of Chester Avenue, between the railroad tracks and the shipping area at the north end, was filled with steam-heated hydraulic presses. That area was always hot, especially in the summer. The cure times for most of the items being molded there were long, some over an hour. So each of the pressmen handled unloading and reloading a group of presses, moving from one press to the next in a sequence that brought them back to their starting place at just the right time. They didn't have a lunch hour, but rather took their lunch during one of the long cure times. So management built a little lunch facility right across the street in a tiny spot just north of the railroad, so they could have a place that they could get to quickly and have lunch and a respite from the heat. One of the employees of the Main Cafeteria brought the food over and served the pressmen. There was never a rush hour, because each pressman's schedule was different.

Spitoons. In the 1950's there was one thing about Inland that was not egalitarian, and that was the spittoons. Many employees were still chewing tobacco or dipping snoose at that time. There were two employees whose full time job was taking care of spittoons. A first level Foreman's office got a papier-mâché bowl filled with wood shavings. A General Foreman's office got a plain steel spittoon, and a Manager's office got a big shiny brass spittoon in the classical shape. The two-man spittoon squad had a large enclosed cart filled with clean spittoons, and they would go to an area of the plant, take the dirty spittoons, leave clean ones, go back to their home base, discard the paper papier-mâché spittoons, clean and refill the steel ones with an odor killing solution, and polish and refill the brass ones. They finished the entire plant in less than a week. The reason for including this description is that a fellow I knew (whose name I remember but won't include) bribed the spittoon squad to give him a brass spittoon rather than a steel one so people would think he was more important than he really was.

Breathable Vinyl. One night at about 9:30 p.m. I received a phone call from Tom Mathues. He said "an attic inventor" had contacted him and said that he had developed a breathable vinyl and he wanted to disclose it to Tom, and I should come over to Tom's house to be a witness, so I went. This must have been in about 1966. I don't remember the man's name, but I remember he acted like it was a very big secret he was divulging. Apparently that is why he didn't try to contact Tom during the day at work. His process was similar to the well-known way cellulose sponges were produced, by incorporating salt crystals into the vinyl while it was being formed and later dissolving out the salt. Vinyl was widely used for automobile seat trim covers because it was inexpensive, durable, resisted soiling, and was easily cleaned. Its main disadvantage was that it was impermeable, so the occupant's perspiration was trapped between him and the seat, which got to be uncomfortable. Therefore, I suppose, the inventor thought he was about to tap into the mother lode.

Dwight Rust was assigned the project of evaluating the inventor's idea, developing compounds, trying different process variables, and making and testing samples, etc. There were no successes. Among other things, when you put enough salt into the vinyl to make it permeable, it clearly did not have enough strength. Also, it had a very soft feel. During the project, Harold Beckerleg, who was the material guru for Fisher Body, was shown a sample – just to show that we were working to develop new things for Fisher Body. (All material changes had to be approved by him.) He unknowingly gave the project a memorable coup de grâce by saying "It feels like the inside of a maiden's thigh."

"Ball Joints" for the 200-Inch Telescope. Inland made some unique products, but the Grand Prize for Uniqueness must go to this product. Here is the story. Recently, in digging out information for this history, I learned, via a 1998 document from Mark Wallace, the designer who drew the prints for the parts, that Inland had made some "ball joint bearings" for the a 200-inch Telescope Observatory. Apparently not very many people knew about that. That finding triggered a memory in my mind of an incident from that 1957 time frame. Max Baker was the engineer who headed the Ball Joint group, and he was telling me that the big telescope observatories were having a problem because they need to move their telescope a very slight amount or at a very slow rate to properly track their target, and the stick-slip phenomenon of traditional bearings was causing their images to stutter, making fuzzy photographs or bad data. Apparently, the increased accuracy demanded by the Space Program was driving them to do something about the problem, and Max thought he could solve the problem with the Teflon fiber bearing material used in our ball joints.

Mark Wallace remembered that the parts for the "ball joint bearings" consisted of a stainless steel ball about a foot in diameter and a stainless steel block about 3 feet square and nearly that tall, into which was machined a hemispherical depression of about one foot diameter. A giant ball joint! He also remembered that 32 bearings were made.

For the bearings to be functional, the stainless steel balls would have had to be exactly spherical and well polished, and the magical Teflon fiber bearing material would have had to been molded into the cavity of the stainless steel blocks. It is hard to imagine what process might have been used to produce the balls, but only one process seems feasible for the blocks, which is: 1) find one of our steam-heated hydraulic presses that would accept something 4 feet tall, 2) put one of the square stainless steel blocks into the press, resting on the heated platen, for a day or two until it got up to temperature, 3) position the round piece of bearing material in the cavity of the block, 4) center the ball on the bearing material and close the press, 5) after the proper cure time, open the press, turn off the steam and allow the whole thing to cool down for a day or two so you could remove the finished bearing.

An article published in 1948, "Engineering Aspects of the 200-inch Hale Telescope," by Bruce Rule, was about the Mount Wilson and the Palomar

Observatories. It revealed several interesting facts. One was: "Rotational support is provided under this ring girder by 32 four-wheeled trucks which roll on accurately ground circular tracks." I accepted this as evidence that the 32 Inland bearings were made to replace those 32 original bearings. The mounting of the 200-inch mirror and its supporting system weigh 500 tons. The dome weighs 1000 tons, so each Inland bearing would be supporting nearly 47 tons. Even the way these bearings would function is unique. In use, the block would sit on the ring around the top of the base and the ball would contact the steel ring around the bottom of the dome. The top of ball would roll on the bottom of the dome ring something like a normal ball bearing, but as the ball rotated, in a vertical plane that was perpendicular to the center of the dome, the bottom of the ball would be sliding, not rolling, on the Teflon bearing material. I tried every way I could to learn "the rest of the story," that is, were they installed at Mt. Wilson or at Palomar? Did they solve the problem? Are they still there? No one knows. I even learned that the man who had been the Chief Engineer of the two observatories, Bruce Rule, was long ago retired but still living at the age of 108. I tried to send him a letter asking him to pull those facts out of his memory. No response yet, and I don't expect one.

"Ball Joints" for an Observatory – a product with a production volume of 32 – how unique!

Deming Seminar. Inland sponsored a seminar for the management people of the Dayton divisions of General Motors Corporation and a few suppliers, featuring the famous authority on Quality Improvement and Effective Management, Dr. W. Edwards Deming. The four day seminar was held on July 12, 13, 14, and 15, in 1983, in the GM Auditorium, located in the separate office building of the former Frigidaire Division, on the east side of Springboro Pike. Nearly 500 participants attended. Dr. Deming was 83 years old at that time, and he had some odd health problems. One arrangement on which he insisted was that a bed be set up off stage so that he could rest during break times if necessary. He specified the model numbers for the box spring and mattress from Sears. We were told that his pulse rate at that time averaged one beat every 13 seconds! Far from the more normal one beat every one second! As it turned out, he never used the bed. He was an inspirational and interesting speaker, and at break times he was still on his feet, with lots of energy, talking to the participants and answering questions.

Extracurricular Activity. From 1953 to 1963, I was Inland's representative to the American Society for Testing and Materials (ASTM), Committee D-11 (Rubber), and Chairman of Subcommittee XXXVII (Dynamic Tests). It happened that two college professors, Cyril M. Harris and Charles E. Crede, were putting together a Handbook on Shock and Vibration Isolation. (It ended up being three volumes.) They wanted to include a Chapter on "Rubber Springs," because rubber, having properties of both a spring and a damper, is so useful for controlling shock and vibration. They had

recruited a well-known rubber expert, through Committee D-11 contacts, to write the Chapter. Apparently, that man was having problems trying to be an author, and he hadn't made much progress, and their print deadline was fast approaching, and McGraw Hill was pressuring them. So they went back to the Committee D-11 people for another recommendation, and the Committee suggested that Harris and Crede contact me.

I went to my boss, Tom Mathues, to see what he thought. He wanted me to do it, because it would be some additional public evidence of Inland's expertise. I was head of the Test Section in Building 13 at that time. I told Tom that given the 'emergency' status of the effort, the only way it could be accomplished would be for me to come to work at 2:00 p.m., handle Inland business until 5:00 p.m., then work on the Chapter until I ran out of energy. So that is what we did. I worked until the wee hours for quite a while, but we met the deadline. This was another example of the flexibility of Inland's management.

Foreign Plants. Inland people established a plant in Matamoros, Mexico in the late 1970's, and a plant in Ponte de Sor, Portugal in 1980. Both plants made some of the same products as the "home" plant (including air restraint modules in Portugal), and were quite successful. The Ponte de Sor plant received the top Portuguese Quality Award in 1986 and 1992.

Photos of Inland Products. If you go to the web site www.usautoindustryworldwartwo.com by David D. Jackson, and in the blue overview area you click on the highlighted "Inland," you get a history of what the Inland Division did in World War II. There you will find 117 interesting photographs of Inland buildings, and of products that Inland made during the war.

Inland Manufacturing Co. LLC. If you get on the internet and search for "Inland Manufacturing," you will get a large number of "hits" with information about Inland Manufacturing Company LLC. That is a new company formed in 2006 to produce new .30 caliber carbines and other guns. Ronald Norton purchased the Inland 'Tombstone' trademark and set up a plant at 6785 W. 3rd Street in Dayton, Ohio.

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Inland, Where Imagination and Performance Were Partners!

Inland, Where Working Was Interesting and Fun!

APPENDIX


Our Business is Keeping Quiet
Perhaps you still remember those days way back when your automobile was apt to roll along the highway with birdies beneath its bonnet—chirps in its chassis—and assorted squeals in its body and springs.
Patiently and persistently top-flight automotive engineers traced down these sundry squeaks and squeals which so often were caused by vibration due to metal meeting metal at inopportune times and places.
That's where Inland comes into the picture. Eventually your squawks about squeaks were translated into a thousand problems for Inland's chemical and mechanical research engineers . . . problems fraught with the promise of a car which would tip-toe along hushed highways.
Myriad problems concerning the marriage of metal and rubber into a quiet, enduring union. Problems of developing new compounds, pioneering new designs, new formulas and methods.
Problems solved so successfully that, today, Inland produces under laboratory control of manufacture, hundreds of parts which cushion shock, insulate against the transmission of sound and smooth out vibration.
Today, two Inland plants employing over 3,600 people, produce more than 425 rubber, metal, plastic and associated products.
Today Inland's research, design, engineering, management, equipment and resources serve more than a score of industries.
And we want you to know that our business is keeping quiet. We efficiently merge decibels and decimals for economical, large-volume production of rubber, metal and plastics to help your product to serve (and sell) better.
INLAND MANUFACTURING DIVISION, GENERAL MOTORS CORPORATION,
DAYTON, OHIO. RAHWAY, N. J.
IF YOU HAVE A PROBLEM PRODUCT, REMEMBER
INLAND WILL MAKE IT STYLISH QUIET, SAFE and SHOCK INSULATED
with Rubber, Metal and Plastics
INLAND

Our Business is Keeping Quiet

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INLAND *WILL MAKE IT* { ***STYLISH***
QUIET, SAFE and
SHOCK INSULATED }

with Rubber, Metal and Plastics

INLAND

A Whisper
that Echoed Round the World
From the Bronx to Bali . . . from Ft. Worth to Foochow you will find the products of a dozen great industries walking on tip-toe as proof of the fact that Silence-by-Inland pays dividends at the box office.
It all started with the quiet wedding of metal and rubber into an enduring union. Inland accomplished it, first, for Motordom's decibel-conscious engineers who well knew that Americans on the move demanded the right to whisper to their motoring companions.
The news about this eminently successful whispering campaign soon echoed round the world of industry, until today, Inland makes some 425 products which cushion shock, insulate against the transmission of sound and smooth out vibration.
Today, Airplanes, Escalators and Streamlined Trains; Automobiles and Tractors; Automatic Refrigerators and Coffee Grinders; Washing Machines and Vacuum Cleaners; Diesel Engines and Outboard Motors—all wear cloaks of Inland-made-quiet.
Today, Inland's chemical and mechanical research engineers continue to make countless contributions to industry—pioneering the development of new compounds, new designs, new formulas, methods and tools.
And today, Inland merges decibels and decimals for economical, large-volume production of rubber, metal and plastics.
It has not taken long for the engineers of America's greatest industries to hear the whisper that circled the globe. Perhaps you'd like to hear all about this so that your customers will hear less—and buy more.
INLAND Manufacturing Division, GENERAL MOTORS CORPORATION
DAYTON, OHIO RAHWAY, N. J.
IF YOU HAVE A PROBLEM PRODUCT, REMEMBER
INLAND WILL MAKE IT STYLISH QUIET, SAFE and SHOCK INSULATED
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DAYTON, OHIO *RAHWAY, N. J.*

IF YOU HAVE A PROBLEM PRODUCT, REMEMBER

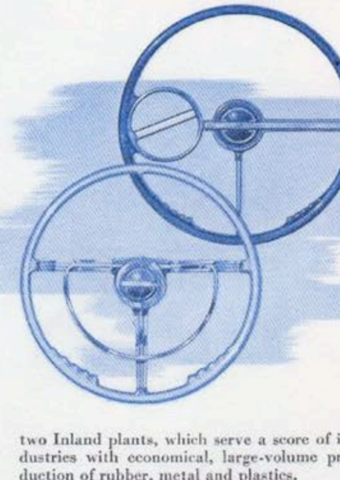
INLAND *WILL MAKE IT* *STYLISH QUIET, SAFE and SHOCK INSULATED*

with Rubber, Metal and Plastics

INLAND

Every Blow *is a Boost*—

FOR OUR CHEMICAL AND MECHANICAL RESEARCH ENGINEERS



Serene and sure and casual, you settle back of your modern Steering Wheel to command with a touch of your finger-tips the course of a hundred purring horse-power.

The next time you drive . . . look, *really look* at the lithe, trim lines of your modern Steering Wheel . . . see the brilliant beauty of its colors and materials . . . feel its sensitive, silent directability.

For years, Inland has worked hand-in-hand with motordom's top-flight designers and engineers to develop the methods, machines, tools and compounds necessary to merge rubber, metal and plastics into the smart Steering Wheels which you handle so effortlessly today.

Let's look in on Inland's Wheel Testing Department—see that heavy tackling dummy relentlessly abuse a Steering Wheel. Yet every terrific jolt and blow it delivers is a boost for the achievements of our chemical and mechanical research engineers.

Over here is a cold test at 50° below zero . . . then comes a heat test of high temperature and 80% humidity . . . now watch the bending test . . . and finally, the fatigue test at 1200 vibrations a minute.

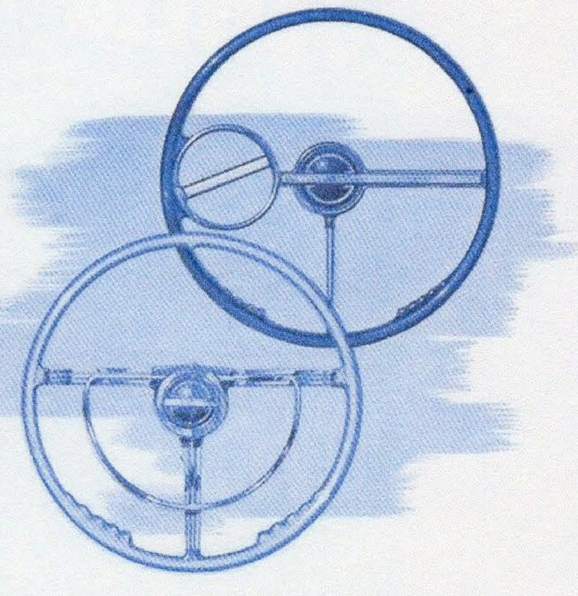
Yet Steering Wheels are just one of some 425 products, produced by the 3600 people in two Inland plants, which serve a score of industries with economical, large-volume production of rubber, metal and plastics.

May we count decimals and decibels to help produce for you a product which is stylish, quiet, shock-insulated and salable?

INLAND *MANUFACTURING DIVISION*, GENERAL MOTORS CORPORATION
DAYTON, OHIO *RAHWAY, N. J.*

Every Blow *is a Boost*—

FOR OUR CHEMICAL AND MECHANICAL RESEARCH ENGINEERS



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DAYTON, OHIO *RAHWAY, N. J.*

Our Watchdogs
wear White Coats
SINCE MEN are only men, and even instrument controlled machinery is fallible, it's a mighty big job to standardize the output of Inland's vast Production Department and turn out, each day, thousands of perfect product facsimiles.
That's the vital job of the trained technicians in Inland's Control Laboratory. Literally, watchdogs in white coats, they enable our chemical and mechanical research engineers to standardize quantity production and assure you uniform product performance.
Step by step, from raw material to finished product, our white-coated watchdogs use scientific instrumentation to check every detail of manufacturing against rigid engineering specifications. These laboratory technicians have the responsibility and the authority to reject any material—shut down any equipment—or release approved operations for further production.
Ubiquitous are the inspection tickets of our Control Laboratory Technicians. They identify every manufacturing process. They ferret out any failure of men or machines. They are the tickets which give our Engineering Department (and yours) a visible record of qualitative control of quantity production.
Laboratory control of 425 separate rubber, metal, plastic and friction material products is a big and vital job at Inland. What's more, it's a job so well done that many of America's greatest industries depend upon Inland for products which serve better because their uniformity of production assures uniformity of performance. May we discuss the possibility of doing the same for you?
INLAND MANUFACTURING DIVISION, GENERAL MOTORS CORPORATION
DAYTON, OHIO
CLARK, N. J.
IF YOU HAVE A PROBLEM PRODUCT, REMEMBER
INLAND WILL MAKE IT
STYLED
QUIET, SAFE and
SHOCK INSULATED
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INLAND

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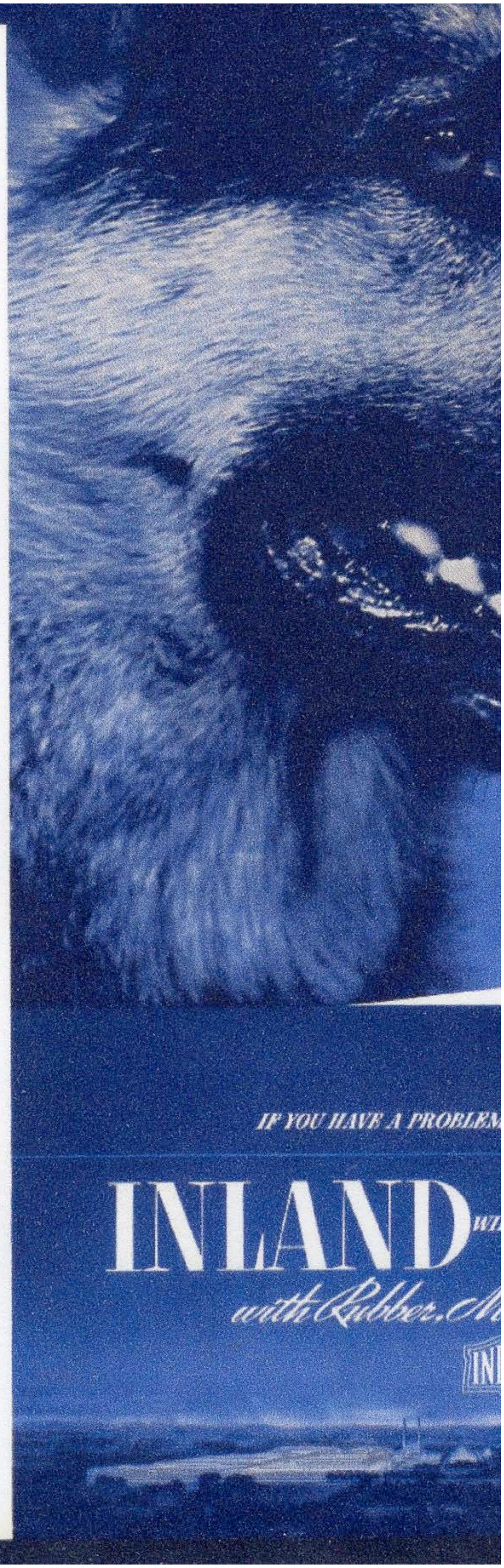
Step by step, from raw material to finished product, our white-coated watchdogs use scientific instrumentation to check every detail of manufacturing against rigid engineering specifications. These laboratory technicians have the responsibility and the authority to reject any material—shut down any equipment—or release approved operations for further production.

Ubiquitous are the inspection tickets of our Control Laboratory Technicians. They identify every manufacturing process. They ferret out any failure of men or machines. They are the tickets which give our Engineering Department (and yours) a visible record of qualitative control of quantity production.

Laboratory control of 425 separate rubber, metal, plastic and friction material products is a big and vital job at Inland. What's more, it's a job so well done that many of America's greatest industries depend upon Inland for products which serve better because their uniformity of production assures uniformity of performance. May we discuss the possibility of doing the same for you?

INLAND *MANUFACTURING DIVISION,*
GENERAL MOTORS CORPORATION
DAYTON, OHIO *CLARK, N. J.*




"HA! _ HA! _ DRIPPY!
I TOLD YOU THAT METAL TRAY WOULD MAKE A SINK-SISSY OUT OF YOU!"
"YEAH! I'M SO WEAK I COULDN'T COOL AN EYE CUP!"
ONLY Flexible Rubber Trays
GIVE YOU ICE CUBES AT THE REFRIGERATOR
A split second after you open the door of your mechanical refrigerator you have ice cubes instantly . . . right at the refrigerator . . . where you want them . . . as you want them and how you want them . . . one or a dozen . . . full-sized, cold and dry. No sticking! No tugging! No wasteful, woeful,
faucet-flooded, "sink-sissy" cubes.
Insist that the refrigerator you buy
comes completely equipped with Flex-
ible Rubber Trays—or to modernize
your present refrigerator get Flex-
ible Rubber Trays from your dealer.
INLAND MANUFACTURING DIVISION
General Motors Corporation
Dayton, Ohio
ICE CUBES INSTANTLY — AT THE REFRIGERATOR

Business

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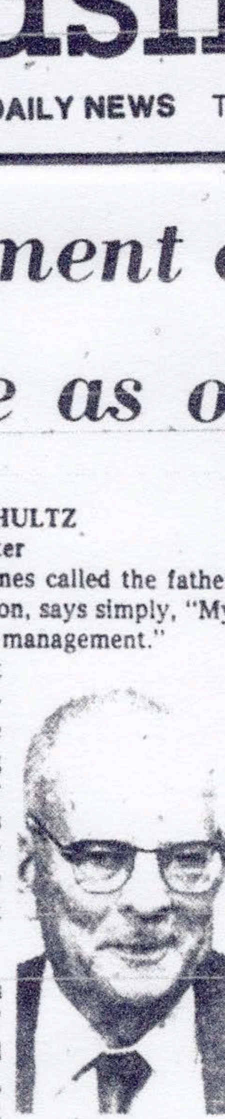
Management expert views U.S style as old, outmoded

By JUDITH L. SCHULTZ
Business Writer

W. Edwards Deming, sometimes called the father of the second industrial revolution, says simply, "My job is the transformation of U.S. management."

Deming, credited in large part with teaching Japanese managers the principles that have made that country a leading world competitor, said today that U.S. management methods "are not only outmoded, they never were right. U.S. industry will continue to decline until it changes those methods."



Deming

DEMING, 83, essentially has been preaching his brand of quality control, production and competitiveness for 40 years, but like a prophet without honor in his own country, it has only been in recent years that many American managers have begun to listen to him. Almost 500 General Motors Corp. managers and suppliers are doing just that during a four-day seminar in Dayton this week under the sponsorship of GM's Inland Division.

Deming finds little admirable or sensible about how American managers conduct business, he said prior to the seminar, held at the GM auditorium in Moraine.

Emphasis on quarterly earnings and stock dividends by U.S. companies is next to immoral because it drains away the savings and the contributions made to the company by its employees.

"Protection of the stock is the goal, but the best way to do that is to stay in business," he said.

"The mission of management is not to be a shuffler of paper profits. That doesn't make the pie any bigger so that more people can share it in," he said.

WHILE AMERICAN manager, in times of crisis, lay off employees first and find other cost savings later, Deming believes that is absolutely backwards. "First you cut dividends, then you cut management. Last of all, if things get really tough, the factory workers take a cut in pay. You don't lay off the people. The Japanese don't lay off. Because, by not doing so, you let them believe in the company and the quality of the product. When you protect the employees, they can work with pride."