

## **My way to my job (part 1)**

When I switched to the tenth grade of secondary school in the summer of 1973, I was beginning to realize that I needed to take care of my future. There was the opportunity to go to high school and graduate from high school. But my notes spoke against it. The second possibility, to make the technical examination after 2 years at a technical high school failed probably also at the grades. The third, and at the same time, most likable option, was a very ordinary vocational training. Another form of employment after school would be a break. But first of all I lacked the money and secondly I lose another year to work. However, for people who want to expand their spiritual horizon in a different way or maybe have a self-finding problem, this possibility is very good. Before one then sits down his years in the wrong profession and is permanently dissatisfied, such a year of self-knowledge is very helpful. It was clear to me very early that I wanted to learn a technical profession.

I could not imagine spending the rest of my life as an office clerk or industrial clerk predominantly in an office. Of course, these office work also have their charms.

I was already working on chemistry before starting vocational training. However, I also had a preference for subjects like physics, chemistry, biology, geology and mathematics (?). But in the fall of 1973, a different perspective opened up for me. On a Friday afternoon, I met my neighbor and he asked me if I would go to an amateur radio course with him tonight. Since I am always very curious, I have also said yes. The course went from 8:00 PM to 10:00 PM o'clock in the Komödienbau in the city center of Weilburg. I had already on the first evening great interest in the topics with electricity, high frequency u.s.w ..

At the beginning of 1974 I had to go to vocational counseling in the Weilburg employment office. When asked about my career aspirations, I immediately said "something with chemistry".

The consultant's answer came just as fast. He said that since there is a larger chemical company in Weilburg, I could do an apprenticeship there as a paint lab technician. He also wanted to make an appointment to visit the company.

That went a bit too fast for me and so we stayed so that I wanted to contact him again. I have to say that meanwhile my interest in electronics was greater than in chemistry. But as an apprenticeship I remembered only the radio and television technician. Since this training also includes the construction of antennas that was incompatible with my fear of heights.

Now, coincidence came to my aid again. During a conversation with one of my classmates, he said that he had applied to Philips in Wetzlar for an apprenticeship as a radio electronic. Then I quickly wrote an application and a CV with my hand and sent it to Wetzlar.

To be on the safe side, I also applied to the Telecommunications Office in Giessen for an apprenticeship as a telecommunications technician (mainly electricity). After some time I got an invitation to an attitude test at Philips. My classmate, from whom the tip came with Philips,

had to go to Wetzlar the same day. We then went by train to Wetzlar and on foot from the train station to Philips.

**The hiring test** started at 8 o'clock and should take longer. First, there was a comprehensive maths test without tools (no calculators, books or formulas). Of course, these were just word problems or geometric tasks. After that, a questionnaire had to be completed. I have two questions still well remembered. First, it was asked if a relative or family member works at Philips and then there was the question of whether to help in the household.

After this questionnaire, an attempt was made from physics towards electrical engineering. The experimental setup consisted of two metal plates attached to holders. The plates were about 15cm square and faced each other vertically at a distance of about 10 cm. Between these plates, a table tennis ball was suspended with a metallic surface movable. Now high voltages were put to the plates (estimated 5000 volts) and the tennis ball moved against a plate and let go again. Now the tennis ball was constantly swinging back and forth between the two plates and did not want to stop. Our task was to describe how it happens that the ball is constantly swinging. We also got a worksheet with text about atomic structure and a picture of Bohr's atomic model.

After this work, there was a lunch break with a free visit to the Philips Canteen. After the break, another test was performed. We got a sheet of paper (A4) with a sign similar to the Greek letter OMEGA. Next to it was a piece of wire and a pair of flat-nose pliers and a transparent adhesive tape. Now the wire should be bent so that the shape corresponded to the mark on the paper. Then this bent wire was attached to the paper with the tape.

Then there was a break, as all participants had to wait for a discussion with the four instructors. It took a while for about 15 participants. At some point, it was my turn and had to answer questions. Now I also learned that I have just split a few atomic nuclei in the explanation of the experiment. I think that if I knew all this well then I would not need to do any training. One of the instructors then said that I can do an apprenticeship with Philips. I could think it over and then call Philips. Since my decision was already clear I have also agreed immediately.

Then I got an invitation to the telecommunications office in Giessen. I then canceled by phone and shortly thereafter annoyed me about it. Actually, it would have been quite interesting how such an attitude test runs at a telecommunications office. First of all, it was important that I had an apprenticeship. At the time, I did not know that Leitz also trains electronics technicians. But you do not want to have everything. Only when it was certain that I could do my apprenticeship at Philips did I learn that my neighbor in Limburger Straße in Weilburg had also learned from Philips and then made his technician. Since he worked in a company that produced electronic kits that were then sold as finished products for a fee, I had the opportunity to produce printed circuit boards at home, And so I was able to practice

equipping and soldering these boards. Among the devices were the then (1974) so popular light organs, digital multimeters with NIXIE tubes and a variety of audio amplifier components. The light organ came to me the idea to check one or all finished boards once. However, this requires a sine wave generator in the LF range. My neighbor got me the components including the light bulb for a Wien bridge oscillator. When the generator went off and a dial was calibrated, testing could begin. This three-channel light organ controls the first lamp in the lower frequency range, the second in the middle and the third in the upper frequency range. Now, if the generator is applied with the appropriate level to the input of the light organ board can be brought through a sweeping of the audio frequency range successively all three lamps to light up. I have to honestly say that I prefer that I spend PCBs that I or another tested as boards that were not or only half-heartedly tested.

Now there was a problem until the start of training. At that time we had some stable rabbits, one of which was pregnant. A few days after the birth, the rabbit died and when two little rabbits died with the same symptoms as the rabbit mother died, the entire cage was disinfected. My task now was to keep the remaining 4 rabbits alive by feeding and more caring. First, I dipped the mouth of the hare in a milk with building materials for little rabbits. When that did not work, we got a space from the pet store and started a new attempt. Again no success, the milk landed on my coat and the little rabbits went empty-handed. Luckily my sister, a trained pediatric nurse, came over the weekend and showed me how to do it. Take one of the roughly hamster-sized bunnies and turn it on its back. Then you just have to drive the suction plug of the surfaces along the mouth until the little rascals have understood the meaning of the exercise. When routine arises, it's really fun. However, the fun also limits if you consider that the little guys all one day on the plate. Since that time, I am no friend of rabbits, no matter in what kind of preparation.

### **Training at Philips.**

Now back to the serious of life. Our training began on 15.8.1974. Now I had to rely for the first time on the public transport (ÖPNV). Fortunately, the train from Weilburg was so early in Wetzlar that I was able to reach the farm on foot. The training was a step education. The first level was reached after two years and was crowned by a final exam. After passing the exam, the profession of the communications equipment mechanic had been completed. Another 1.5 years of training was terminated by another final exam. Now you could call yourself radio electronics. This occupation belonged to the occupation of the information electronics and the Industrial electronics engineer / specializing in equipment technology to the occupation of the industrial electronics. When we arrived at our apprenticeship at Philips shortly before seven, we saw that for the first time, who started the training with us.

The group was mixed and consisted of apprentices for the profession of toolmaker, radio electronics technician, industrial clerk and a technical draftsman. First, the instructors were

introduced. There were two for mechanical training and two for radio electronics. I believe that the merchants had only one instructor. Then there was a nice group picture in color in front of the entrance to the canteen and then it was already in the training workshop. I thought yes, that we made only once again a small tour of the company but there was still time later.

Incidentally, at Philips in Wetzlar with about 1,100 employees car radios of the upper price range (ie FM stereo with cassette drive and traffic decoder and later with digital receive-frequency- display / as of mid-1978) In addition, also transformers (Schnittbandkerntrafos) were produced for television technology.

Now it was time for the safety briefings. Of course, we were told where the fire extinguishers are and where a fire blanket was. What I remembered was the hairnet that trainees with longer hair should wear on the column drill. It should probably have happened once before, that the hair of an apprentice had fallen into the running spindle and were then wound up very quickly. The second concerned a pneumatic gun with the shavings of workpieces should be removed. At some point an apprentice must have held this pistol against the anus and pulled it off. So much air from the outside did not do the gut any good. The apprentice had to be treated in hospital. I always like it when such prohibitions are made clear with an impressive example. Next we got our work clothes (a chic mouse gray one piece with Philips logo and front button placket). Since I was not the biggest one at the time, even the smallest model did not suit me well enough. When I let my arms dangle down



my little body, my hands slid down my sleeves. If I had put myself on an open field with this model and then spread my arms I would make a great scarecrow. When I rolled up my sleeves the day could start for me. By the way, the accompanying book has accompanied us the first years of our education. This illustration is my book, which has been around for 45 years with coffee stains, ashes and breadcrumbs.

The training workshop for metalworking was about 10m long and 5m wide and was located on the ground floor. It was at one end of the premises and adjacent to the football field of Philips. On the long side were industrial windows and there were also some workbenches. A second row of these tables was about 1m parallel from these tables. Also on the left side of the workshop seen from the entrance there were about three workbenches. At the far end of the room was the instructor's refuge. To protect against prying eyes his work area was almost completely covered with glass. A door in this aquarium allowed the flight to the front. On machine tools there was a column drill. A turning and milling machine. In the room was also a bench (for metal) a grinder and a furnace for hardening of workpieces available. At one end of the room was an area containing the lockers and washing facilities.



The picture on the left shows the training workshop in 1974. The photographer of the picture is unfortunately unknown.

If you ever got to look out of the window (so constantly) you had a good view of the football field and the adjoining allotments. Since Philips felt committed to the sport, there was still a small outdoor pool with sunbathing area and sports such as table tennis and bowling were also offered and promoted on the premises. It slowly became

apparent who wanted to take which profession. There were 7 trainees who wanted to learn electronics (later came one more) Fortunately, there were two women, the other men (I call myself for simplicity's sake as a man) have educated to a respectful behavior and decent behavior. Another woman, the technical draftsman, has also joined. The first day was very hot and the work rather unfamiliar. We had to file a paperweight from some parts of metal. The consisted of a base plate and a cube which was screwed with a tip on the base plate. Further more or less meaningful works were a scriber, grains, a hammer and parts, with which certain processing steps were learned. We were also allowed to solder aluminum enclosures or HF-tight tinplate housings together. The side parts were soldered with a hammer soldering iron. Normally, the soldering iron was in a storage device. For me, the soldering iron slid out of the holder and I instinctively reached for it. At the same time I got to catch him at the hot end to let go in the same. It's great when the smell of a charred palm decreases. There are no bubbles at all. I would rather have gone through this experience theoretically. My biggest problem was making a Right Angle. Everything had to be right. Our instructor was also a bit strict. In general, it was strictly forbidden to throw mechanical gauges such as calipers or right angles on the table. During the apprenticeship there was also April 1st including April Fools. An apprentice was sent by our instructor to the material store to get 300 rivet head bolts. When he came back he told us the following. In the stock he asked the campist to give him 300 head cap screws for the training. Then the man looked at him and asked the apprentice, which day would be today. He said Thursday. Then the man said he should not say the day of the week but the date. Then the trainee said April 1st. This was acknowledged by the storeman with a friendly "there you look" and disappeared. Honestly, I would have fallen for it.

### **Electronics training.**

After half a year, the apprentices from the apprenticeship workshop for metal and plastics processing then moved to the training workshop for the future electronics technicians for the electronics apprentices.

The workshop was on the first floor and was accessible via a staircase on the corner of the building (no elevator).

The training workshop was divided into several rooms. When you opened the first door you came directly into the classroom with school desks and blackboard. To the left of the door was our small warehouse with what you need every day on components. Then it went through a wide door in a passage where also the training place for the technical draftsman was. Through the next door you came into a small workroom and the office of our instructors. And now you could get through the last door in the actual work space for the trainees.

After half a year then threatened already the first intermediate exam for the training to the communications equipment mechanic.

Above all, we learned to wire power cords to a perforated plate. This included the correct stripping of the wires and the provided with a wire end ferrule. In addition, fuse holders, lamps with sockets and buttons and switches were mounted on the sheet metal. Of course, soldering with electronic solder was also included here. Then came after a year the day of the intermediate examination. The examination consisted mainly of the areas of metalworking and about 30% of the Department of Electrical Engineering. The first intermediate exam and final exam for the communications equipment mechanic were carried out together with Leitz apprentices. During an exam we were in the training workshop of Leitz at the Hausertorwerk and the second time the Leitz apprentices came to Philips.

Now something to the vocational school. After the dual training system, training consists of a practical part in the training company and a theoretical education in vocational school. One often finds the block lesson. Here are the trainees for e.g. 4 weeks throughout the theoretical training (weekend probably excluded).

During my apprenticeship there was once a week a vocational school day in the Werner von Siemens school. There the first two years were also the apprentices of Leitz and the trainees in the profession of radio and television technician.

Already on the first day in school, we got to know the slide rule. He should accompany us from there to the final exam in 3 ½ years. It takes a bit of practice to get the right results with a slide rule (or a rule bar). Although in the following years, the calculators were always cheaper and were available with more features were held fast to the slide rule.

Philips had a special case. We had the so-called Werkunterricht during operation. He also took place once a week. Here we were introduced by our trainers in the wonder world of technology. Tricky things were also explained using a test setup.

After passing the intermediate exam, the trainees were placed in different departments at Philips for three months each.

The departments were the measuring department in which the measurement setups for the production (car radio and transformer production) were developed, constructed and installed

in test tables. Then there was also a quality control for car radio and transformers). a repair department where Philips equipment was repaired. Here, Philips employees were able to return everything from the TV, radio, vacuum cleaner to the razor for repair.

The trainees were of course also employed for 3 months in production or in the training workshop. In production, we came to an experienced employee and got to know the troubleshooting and repair of the new equipment.

Incidentally, our working day started at 7:00 am and ended at 4:00 pm. In some departments there was flextime, which did not apply to the apprentices, even though they worked in the department for three months.

**Now a few small memories of the time in the different departments follow.**

**Of course, I can not play in the departments all the time like a diary. Here I have only mentioned the extraordinary events that have been well remembered.**

When I was in the **measurement department** as an apprentice I got an interesting job. I should build a backpack. Curious as I was then I asked what a backpack is. The answer was that a backpack was something for private use. So something that you could take home. My backpack was a digital clock four-digit without alarm. That was in the seventies. When everything worked after the assembly, I finally was satisfied.

In another case, I should install together with the son of the managing director two test tables. This was similar to the products of a well-known Swedish furniture store that starts with IK and ends with KEA. The colleague hastened so much to tighten the nuts with the open-end wrench that slipped in the hand and hit against the metal table. When I heard that, blood was already running out of the backs of his hands. So we went to the company doctor, who disinfected his hand and connected with a lot of gauze bandage. From now on, he was forced to work considerably slower. But we finished our work on time.

My next journey took me to manufacturing for three months. The production probably made up the largest part of this building in terms of area. The hall had a rectangular area. On the long side was a path at the level of the first floor, which extended further over the narrow side. The training workshop electronics, the measuring department and the department for quality control –car-radio were reached via this route.

The manufacturing consisted of 4 or 5 production lines and the area for manual assembly. Each line was designed for a different car radio model. The essential of these production lines was that it was a transport belt (we trainees called it a conveyor belt).

On the sides of the conveyor belt, the individual jobs were housed. These places differed in testing, assembly, repair and troubleshooting stations. While the testing and assembly stations were occupied by semi-skilled workers, the repair and troubleshooting stations were staffed by skilled workers (such as industrial electronics or radio and television technicians).

The conveyor belt (assembly line) transported the electronic components in plastic containers to the individual workplaces.

As trainees, we were only used at the places for troubleshooting or repair. There, the old hands showed us their tricks. Of course, we were not only allowed to watch but also had to look for bugs ourselves or PCB and mechanical components such as Repair scale ropes. At the test sites sat according to my knowledge only women. At these places there was an adapter that contacted the measuring points on the circuit board via test probes. Now the semi-skilled could connect measuring points with the measuring devices over a keyboard. If one of the measuring instruments showed an incorrect value, it was written in short form on a piece of paper and handed over to the troubleshooter with the defective printed circuit board. For example, a too high power consumption with an "" I + "" was noted on the slip. When the troubleshooter found the fault, the electronic component went to the repair site. After the repair there was a new start at the test station.

Minor repairs have also been done by the troubleshooter. However, he does not always have all components in stock at his workplace.

Then I was in the department of quality control car radio. I was already surprised with which technical effort the quality of a car radio is monitored. In addition to the usual devices such as oscilloscope, transmitter up to 150 MHz, AC voltmeter, test device for the cassette drive, there were a few other devices. So there was a climatic cabinet, a vibrating table with the inscription "" MADE IN GDR "" and a device similar to a seesaw. This case samples of packaged car radios were made. The drop height was 1m on concrete floor. Of course, such tests should also be reproducible. A test setup aroused my special interest. Here you have set up the tuning unit of a car radio. The tuning knob was constantly moved to the stops with a motor. A strain gauge was mounted on the axle. This was used to measure the forces acting on the axle. The results of hundreds of movements should not differ significantly from those of hundreds of thousands of movements.

One of my work was to get original boxed car radios directly from the factory and check them. When I carry the radios a lot of strange rattling on me. Arrived in the department, I rattled the device and grabbed it. When the clatter seemed to come out of the unit I opened the lid and countered a lot with a M5 nut. I just imagined what a customer would have said to this surprise. The M5 nut is usually attached to the device as an accessory, but usually not in the car radio. Testing the devices was not about turning it on, I hear something and good. Here, the RF sensitivity in decibels, the channel separation in FM stereo and the cassette drive and a few others were measured. These measured values were then entered into a measurement record and filed.

An employee of the quality control car radio was also a radio amateur. So I have some tips from him take away. When he built a power amp for that 2m band I could see how it works. In



addition to the chemicals such as photoresist, developer and etch chemical, it took some practice to make such a circuit board. When I tried the home then my photoresist had a surface like an emery paper after drying and was not to be used.

Next, I was in the **department where we repaired broken Philips products** that belonged to the employees in Wetzlar. There was everything from the TV, vacuum cleaner, coffee maker to hair dryer and razor. In the workshop were only the boss and a trainee. First I tried a portable radio. I found a broken transistor but only as a comparison type in the warehouse. After the installation of the transistor was nothing. Only later did I learn that the pin assignment of the comparison type looked a bit different. At some point I discovered my preference for broken razors. In a cordless razor, I exchanged the battery pack and had to watch that the customer scolded powerful when picking up the shaver. She said that she should pay more for the repair than for a new razor. Maybe you should get a quote first. I do not want to know how often the lady at the customer reception had to hold such talks. One day I got my first Ladyshave, a razor for ladies and those who want to become one. I've heard of it but never had such a small haircut in my hand. When looking at the blades I noticed a label. On the one side of the blade "ARMS" was so little arms and on the other side was "LEGS" so little legs. Then I have to decide whether women who use such a device always know exactly where their legs stop. Then I imagined in my mind where the little guy has already raged everywhere. One should not take such thoughts seriously, but nevertheless I washed my hands thoroughly after every job. Maybe I should have looked at the woman who considered this ladyshave their property. But it could also be that the woman was the grandmother who gave this device for her 24-year-old granddaughter. The repaired Ladyshave was then tested by my boss. He pushed up his sleeve and shaved his stubborn forearm with this ladyshave. I would be interested to know if he took the " little legs " blade. After that I came to the quality control transformer. I was a little surprised that except for my instructor and myself, only women were present. That was also the first time that I got a teraohmmeter here. 1 teraohm are at least 10 exponent 12 or 1,000,000,000,000 ohms. My job was e.g. in re-testing transformers that have completed a climate test. If you knew the test setup, only the measured values had to be entered in a given form. Of course, there was still time left to make their own experiments. So I wanted to know at what temperature triggered the built-in transformer fuse. In addition, some transformers had very good voltage and current ratings, so good for a hobbyist. A rather large cut core transformer had about 14 V output voltage (AC voltage) and that at about 3 A current carrying capacity. That's exactly what such a small radio amateur needed for his radio. Of course, I have previously asked my instructor if I can take such a transformer, if he has survived the climatological test and should be disposed of. Once I did something completely different. My instructor saw an engraver at our apprentice instructor in the mechanical workshop. And so I got the order to

build such an engraver for the department. After 2 days in the training workshop, the engraving machine was finished.

Of course we also spent some time in the training workshop. There we had a trainer and a co-trainer. Sometimes we also had to prepare the experiments in the classroom. Also the tidying up of the warehouse and the sorting of a 1 kg bag with resistances stood on the program. After sorting the resistors with the color code, this code had been internalized. Of course we also had time for three months service in the training workshop. There were some fun experiences here as well. For example, a trainee once exploded a larger electrolytic capacitor from a power supply (perhaps 4700  $\mu\text{F}$ ). Then we should make a transformer (EI core) ourselves. The bobbin consisted of Pertinax panels cut to size with a jigsaw and then glued with two-component glue. After applying the windings and fitting the transformer core, there was the obligatory high voltage test (about 5000 V). We were shown an error and you could see a weak light band at the cut lines executed in pencil. We have then all visible pencil lines (graphite is conductive) vigorously cleaned and partially scraped. After this ordeal, the high voltage test was passed. Learned something again. The next time I try to mark the cut lines with a scribe.

#### **Here are some more anecdotes from the apprenticeship:**

About half a year after the start of training, three trainees from our apprenticeship year were selected to take part in **educational leave**. This form of further education existed in Hesse only from 24 June 1974. Since I was one of the three apprentices, the joy was already very large. The holiday organized by the trade union IG-Metall took place at the Jugendhof Dörnberg near Kassel. The word vacation can be completely misunderstood. We had a tight daily program with discussions, planning games and above all the exchange of information. Since all participants were apprentices in the first year of apprenticeship, they were able to learn something from the experiences and impressions of the other course participants. In this one week, however, there was no electricity or electronics to hear. An experience of a special kind was for me a look over the fence in the GDR television. It was just coincidence that I suddenly stood in the TV room in the youth center and the TV was running. Later I learned that I had seen the Black Canal with Karl-Eduard von Schnitzler. The way in which the West was reported here could scare you. However, at the time I was not particularly engaged in politics. But I thought of my grandmother (paternal) who lived in the GDR and perhaps this show looked. But it did not go so far that my grandma called us every week and asked if we were fine and we had enough to eat.

I had a **second educational leave** in the middle of my second year of apprenticeship. This time, the educational leave was organized by Philips and so only Philips trainees from the Philips branches in Germany were involved. The venue was Malente in Schleswig Holstein. The arrival took place in the first class compartment with reservation to Hamburg.

There we stayed in a youth hostel. Before going to bed, we went to St. Pauli for a short bowling. Incidentally, we were from Wetzlar for two. My trainee colleague was training as a toolmaker and in the same apprenticeship year. When we arrived in Malente by bus, we had some rest to acclimatise. Of course, this time we had a more direct comparison between the trainees, as they were all in the same year of apprenticeship. Again, it was discussed again and there were simulation games. The exchange with like-minded people also offered the opportunity to experience the design possibilities during the training. I can still remember a situation quite well. We were all in a large group room at a large table. Now someone should say a keyword such. As skyscraper or plane and the next participant had now spontaneously hold a one-minute presentation on this concept. Everything went well up to my front man. My front man was probably a little comedian and said athlete's foot. I had some difficulty in saying anything about this term. Of course, there was no rating for all the games. The last day was a scavenger hunt through the whole place. You probably can not imagine today that you can do this without a smartphone and the corresponding apps. The educational leave has definitely given me the opportunity to think outside the box. The closed friendships do not last very long, as is often the case.

I just heard a funny story, but I just had to believe it, because you can not really come up with something like that. At Philips, there was a need to increase the quality even further. This should be a challenge cup with the beautiful name "The Golden Q" serve. This trophy was then assigned to the production line, which achieved the best quality.

Now the task was occupied by a designer who soon also forwarded a sketch with measurements to the training workshop. With such one-off productions, one has always been happy to commission the toolmaker trainees. When the cup was finished, the designer came to see the good piece. He was astonished when he saw that the trophy was very small. The mistake was found quickly. The designer has specified all dimensions in centimeters but this is not noted anywhere. If a mechanic sees the measure 20, he expects 20mm and not 20 cm. As a result, the trophy was 10 times smaller than expected. From this I have learned my lessons and usually pay attention to measuring who gets to read them. When cutting wood, I take inches and write that extra on the drawing. Of course you do not have to do every mistake yourself. But one notices one's own mistakes especially well.

The test after two years to the communication device mechanic was then also passed. At some point we started to meet in the cafeteria on Wednesday after work. On that day the rooms were open because there was a group of table tennis. Even the chef was still present and so we could each get a beer in the basement at the bowling alley. In such group work, the good is, if one is not wise, then it may be another. We once puzzled over what the C in the term CMOS means for integrated logic circuits. When we asked our Vocational teacher two days later, he said it was shot dead, that the letter C stands for carbon. But that was very

strange and so we asked our instructor. He explained that this C stands for complementary and thus the wiring of the output stage is meant. A look at a datasheet of such an integrated circuit confirmed the statement of the instructor. One should not always believe everything that is said so. I already had my experiences there.

**The final exam** was divided into a theoretical and a practical part. The theoretical part consisted of the so-called multiple-choice procedure. Here, for each question, there is e.g. 4 answers. For some questions, circuit cuttings were shown. Some questions could also be expected (with the slide rule).

After this show of strength came the practical test. Here we had to equip two printed circuit boards with electronic components. Both boards had the euro format of 160 x 100mm<sup>2</sup>. In one plate, the tracks were made of copper on the board (laminated) The second circuit board consisted of a breadboard. These boards usually consist of a 1.5 mm thick paper or epoxy board. On this plate then joins a hole to the other. All with the same diameter of about 1mm and a distance of 2.54mm. That's 1/10 inch (inches). The distances are chosen so that most leaded electronic components have such a wire spacing or a multiple thereof. When positioning the components on the breadboard, we had a free choice. The wiring on the underside was made with thin tinned copper wire with a diameter of 0.8 mm. To better solder the wire to the component, there was a circular copper surface around each hole. The wire on the bottom should be laid straight and 90 degree kinking. Another problem was that there were as few bridges as possible. A bridge is a connection that continues on the bust. Only far-sighted advance planning can help here. The function of the circuit was once an amplitude-modulated medium-wave transmitter and an evaluation unit for the modulated signals.

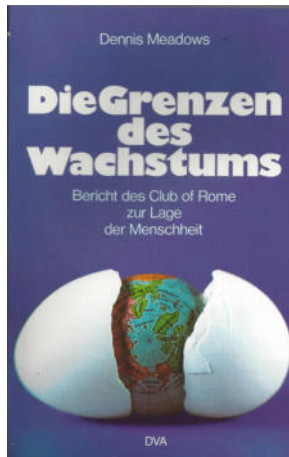
Next, the two boards were put into a prepared Euro card carrier and put into operation. Troubleshooting and repair were not always excluded in the ready assembled printed circuit boards.

At the next test, we had to quickly find and find a fault on a printed circuit board. The error was not allowed to be fixed so that others had fun with it.

Finally, we should make a circuit diagram with the values of the components from a populated and single-sided copper-clad board.

In the end, everyone passed the exam and after a small speech by the training manager we rushed full of energy (?) To the jobs assigned to us. So now we had a job and at last we could make a big buck.

I still do not know how to make big money without becoming criminal.



Since I was not able to sleep a bit on my way to work on the train in the morning, I just read a book. Besides some books on electronics, my curiosity about a book I borrowed from the library had fallen. This book is called "Limits of Growth" by the Club of Rome. When I remember the content of the book at the age of 17, today (2019), at the age of 61, I have to realize that people have not learned anything about it. Although everyone should realize that the planet's resources are finite, we live as if we have at least one planet left in reserve. In my opinion, this attitude

will put as much pressure on future generations as climate change.

The upper picture shows the cover of the 15th edition of 1990. ISBN No .: 3-421-02633-5.

The first edition was published in 1972.