1 NOVEMBER 1979 (FOUO 1/79) 1 OF 1

JPRS L/8747

1 November 1979

West Europe Report

SCIENCE AND TECHNOLOGY

(FOUO 1/79)

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200020002-5

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FEDERAL REPUBLIC OF GERMANY

MICROPROCESSOR TECHNOLOGY IN HEATING, MANUFACTURING DISCUSSED

Munich RATIONALISIERUNG in German Jul-Aug 79, pp 185, 186, 191, 192

[Article by engineers W. Menges and D. Rebel, Augsburg: "Microprocessors and Machine Construction (II)"]

[Text] This article illustrates with the aid of several example applications the areas of machine construction where a penetration of microelectronics, especially microprocessors, has already occurred or is to be expected. This part continues the discussion started in Part I (RATIONALISIERUNG 4/79, pages 87-90) which dealt with the construction and functions of microprocessors and microcomputers.

As a first example, the application of microelectronics in a so-called block-heating power plant [Blockheizkraftwerk] (BHKW) will be described. A BHKW is an installation which consists of several small diesel or gasoline engines. They have been shown very effective lately for the production of electricity and heat close to the point of consumption, especially for heating apartments, industrial facilities, swimming pools and similar dispersed heavy consumers. The basis for this successful application is their very high overall efficiency which is near 85 percent and, in combination with a heat pump driven by secondary energy, can amount to distinctly more than 100 percent of the heat content of the fuel used. Figure 1 shows a schematic of such an installation.

The function will be described briefly without going into technical details. High efficiency for good economy requires optimal tailoring to specific consumption. This fluctuates markedly, however, according to momentary weather conditions as well as time-of-day and time-of-year conditions. These variations could of course be provided for by a large, continuously operating plant frequently running at only partial load. Flexible accommodation is made possible, however, by several small engines which are turned on and off according to demand. Distributing the task to several engines in this manner yields the advantage of higher operational reliability of the total system.

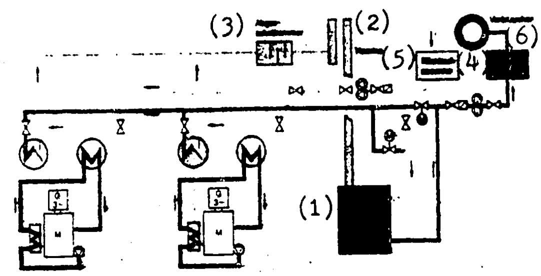


Figure 1: Schematic of block-heating power plant (BHKW) for indoor swimming pool

Key:
1. Boiler
2. Chimney
3. Exhaust muffler
4. Forward distributor
5. Return collector
6. Consumer

Figure 2 shows a sample unit with six engines. The fuel energy is used as follows: About 34 percent is turned into electric current by an attached generator; about 48 percent is recovered as useable heat from the heat of the engine cooling water, lubricating oil and exhaust gas; about 15 to 18 percent of the energy goes out the chimney and is lost in the form of miscellaneous thermal radiation.

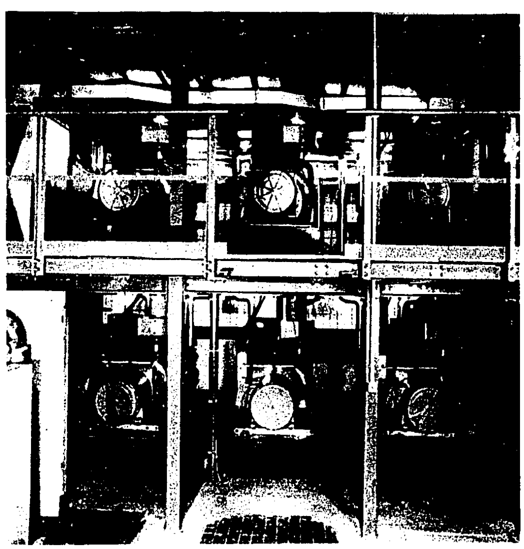


Figure 2: Drive unit of block-heating power plant with six engines

The fact that, in such a complex installation, a large number of parameters must be measured, valves and switches actuated or operating conditions displayed can be clearly seen in Figure 1, and this schematic shows an installation with only two engines. As a rule, however, a significantly larger number of engines are connected together in a BHKW. Microelectronics alone has made it possible to develop an economical, fully automatic monitoring and control system.

Electronics takes care of the sequential operation of all the individual units--engines, generators, heat exchangers, heat reservoirs, conversion pumps, peak-load boilers, ventilators, safety devices, and so forth, corresponding to the time-of-day current and/or heat demand. In particular, the microcomputer (μC) controls the ventilation of the engine room, the starting sequence of the individual engines and their auxiliary equipment and the switching on of the generators, be they of the public or the internal power network. The μC provides--and this is extremely important for the life of the installation--that the individual pieces of equipment operate for equal times through alternate switching. The μC monitors and controls, in addition, the operation of the installation with respect to prescribed coolant temperatures, operating temperatures, on and off times and notes possible engine or generator malfunctions. The type of malfunction is automatically recorded by the μC.

The advantage of microelectronics is that control hardware once developed can be tailored to varying task requirements by the software without having to develop new "wiring schemes" for each new case. This yields an economical price and promotes market acceptance of the product.

We can derive from this example one of the most significant developments of microelectronics: Through high "apparent intelligence," which is associated with large volume and high speed of information-processing in a very small space, it becomes possible to realize complex measuring, sequencing, and controlling functions which, for economic reasons, were hardly possible until now. Products are now created, such as BHKW's, which did not exist in this form before. Only the potential of such complex information-processing makes the design of such complex systems possible.

Multicolor Printing Press--Automated Set-Up

The preceding point becomes even clearer when one considers the second example, which comes from the printing industry. Setting up a printing press is a very complex, time-consuming and expensive process. Thus, especially for repeat orders, a reproducible set-up of the color preparation for achieving a staisfactory, uniform printed picture is of great importance. In this connection, when using conventional procedures not only long rigging times must be allowed for but also high and consequently expensive paper waste. A system which could simplify or even replace the tedious and difficult manual set-up--with reasonable investment and operational costs--would be accepted by the market immediately. The design of such a set-up system only became feasible with the advent of the microprocessor, as is shown by the following brief sketch of such a "MAVO" machine set-up system.

Parameters for rigging a printing press relate to the inking machine; that is the ink supply which is controlled by the gap between the blade and the press, the wetting system, couplings, tube rolls, turning bars, feed paths, web-break detectors and the folding mechanism. The resulting data flow can be processed reasonably and economically only by a distributed, microprocessor-controlled computer system. In this process, the μC of the set-up system communicates with the μC's of the individual inking devices. By the use of an additional μC system, it is further possible to perform the necessary adjustments through direct sensing of, for instance, a master pattern film.

Two service consoles are shown in front of a schematic of a printing press in Figure 3. On the left console, the magnetic-tape-cassette input unit is clearly visible. To the left of this is seen a part of the large display screen on which, for instance, the "analog" output of the printing-press colorimeter can be viewed. The right console shows the automatic film sensing installation.

With this example it becomes clear how microelectronics can upgrade an existing product and increase its ability to compete.

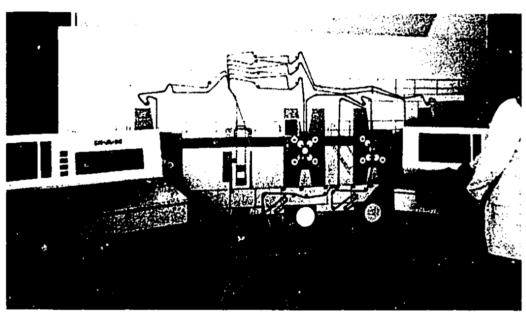


Figure 3: "MAVO" press set-up system and schematic of printing press

Improved Elevator Control

As a further example, from the field of conveyance technology, a large elevator installation is chosen, and for simplicity only one car of several will be considered. Here, the measuring, sequencing and control information processing section is relatively large in comparison to other types of machines.

Figure 4 shows schematically the layout of this elevator. The "power section," for instance, consists of the elevator car, drive motor, guide rails, tach generator, suspension and lift cables. This portion represents about 75 percent of the value of the installation. It is easy to see that this section cannot be replaced by microelectronics.

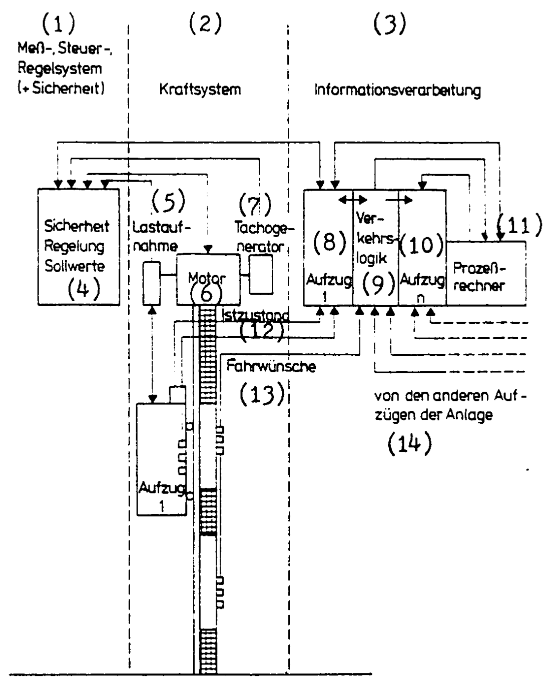


Figure 4: Schematic of one elevator of a multi-elevator installation

Key:

1.	Closed-loop control	8.	Elevator 1
2.	Power section	9.	Traffic logic
3.	Information-processing system	10.	Elevator n
4.	Reference values	11.	Process control computer
5.	Load transducer	12.	Present state
6.	Motor	13.	Trip selection
7.	Tach generator	14.	From other elevators of complex

In order to start the motor, to accelerate, to brake, to stop in case of failures, etc., a measuring, sequencing and controlling section is required as shown in Figure 5. This switchboard contains, among other things, the controller for the drive system, the reference value transmitter which computes the optimal trip sequence, the monitoring sensor and the thyristors for controlling the field excitation of the d.c. generator. Further, belonging to the measuring section are, for example, the load-measuring unit, the present value indicator which reads the output of the tach generator and the push-buttons which input the floor selection.

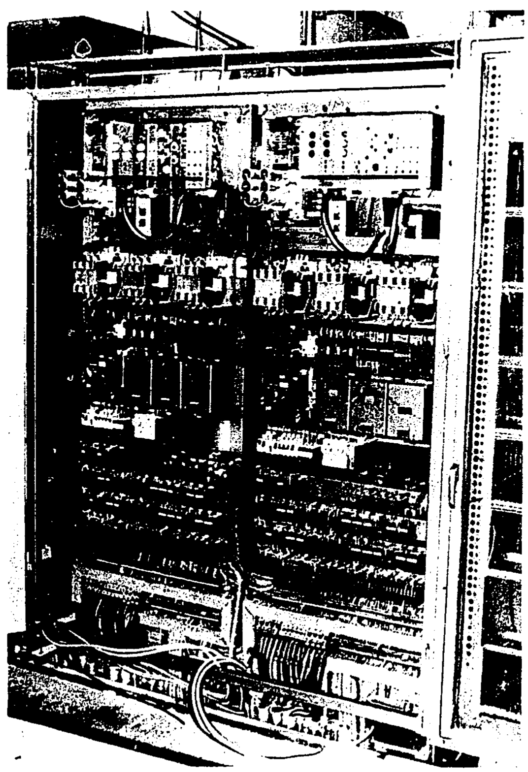


Figure 5: Cabinet containing switching, safety and control units for an elevator installation

This section amounts to about 5 percent of the market value. A penetration of microelectronics (μE) is to be expected here in certain areas, such as the controller and reference value transmitter sections, but not, however, in sections related to power sensing, thyristors, etc., since μE cannot switch power.

The large-scale information processing section with its extensive "wiring harnesses" as connecting elements is shown in Figures 6 and 7. The process computer which is also required is not yet in place. The information section amounts to about 20 percent (in some cases up to 35 percent) and must process the complex logical relationships which result from questions like the following:

- At which floor is an elevator needed now?

- What is its destination?

- Which elevator is nearby?

- Is the door of a particular elevator open or shut?

- Has a floor already been past or can a request still be satisfied?

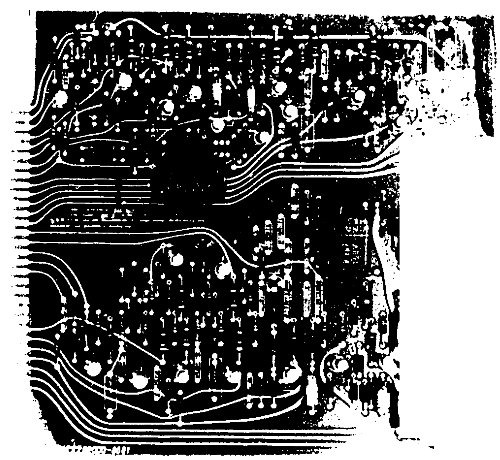
- Can the brakes be actuated under present conditions without exceeding optimal human response limits?

- Is the car already full or can additional passengers be taken aboard?

All of these functions, or the decisions derived from the list of questions, are still, today, realized mainly through the use of lots of solder, resistors, transformers, etc on circuit boards (Figure 8). These circuit boards will be replaced in the course of time by highly integrated microelectronic modules. In addition, the very heavy wiring harnesses will disappear and be replaced by "multiplex systems" using so-called busses. A "bus" is a type of circuit in μC systems over which many different types of information can be sent simultaneously to their individual, addressed destinations, thanks to the ingenious "traffic control" of the individual data items by means of microprocessors (see Vol 4/1979, p 88)

Figure 6: Information Section of a multiple elevator complex

Figure 7: Connecting cables between individual information units and controlling computer



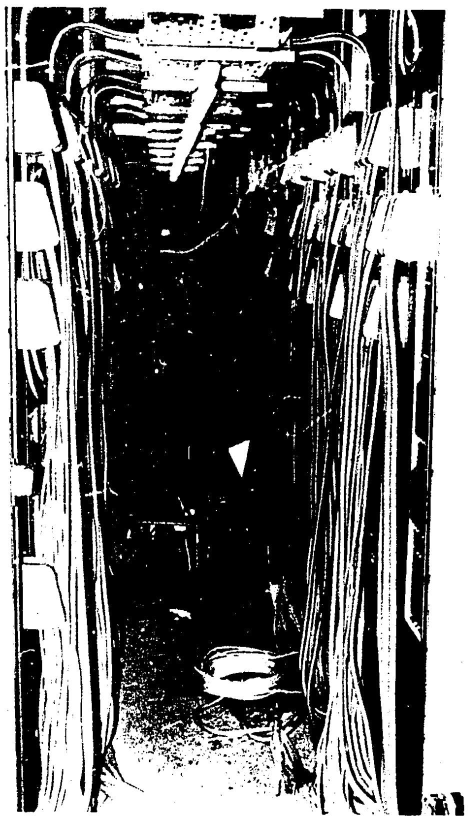


Figure 8: Individual function unit employing discrete-element technology

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New Perspectives in Machine-Tool Construction

A machine tool is used as the final example since the application of μE in this product has effects on the whole metal-working industry. The new machine-tool generation, the CNC (Computerized Numerical Control) machines, make it possible to realize significant time savings in the fabrication of metal parts by the usual steps of turning, milling, grinding, punching and drilling, for both simple and complex parts. In contrast to the usual NC machines, they permit direct intervention in the machining process. Hand-input control makes programming at the machine also possible; large programs can be tested and, if necessary, corrected. Simpler parts are economically programmable directly on the machine. Every part exhibits the same quality, the same tolerances--expensive reworking is eliminated.

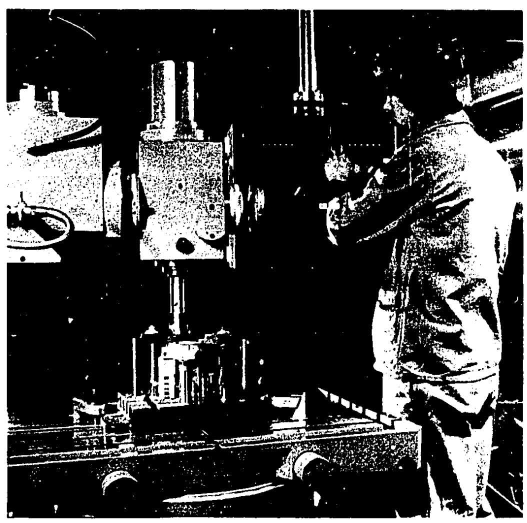

Figure 9: Modern CNC milling machine

Figure 9 shows as an example a milling machine and its associated hand-input control. Experience to date shows that the use of these machines provides a motivating work enrichment since direct programming and optimization of the CNC machine once more fully utilizes the special talents of the operator.

In this example one can recognize an additional effect on μE. The incorporation of μC in products for the production of other products not only affects the producer but also the user. Further, it is clear that the machine operator's job is dramatically restructured. Naturally, this also affects the training of all craftsmen involved.

Summarizing:

Here, once more, are the most important conclusions to be drawn from the selected examples:

1. Microelectronics leads to new products which heretofore could not be realized due to complexity (example, BHKW).

2. Microelectronics upgrades existing products and creates greater comfort (example, printing machine).

3. Microelectronics displaces existing products or product components and thereby lowers the cost of production, especially by replacement of mechanical parts by electronic components and by replacement of wire and solder by miniaturized logic components (example, elevator).

4. The incorporation of microelectronics in products lowers their costs while maintaining or enhancing their flexibility (example, CNC machine tools).

5. Microelectronics influences training and job requirements from the machine operator right up to top management.

9160
CSO: 3102

FEDERAL REPUBLIC OF GERMANY

PRIVATE EFFORT TO DEVELOP SYNTHETIC FUEL REPORTED

Hamburg STERN in German 6 Sep 79 pp 274-276

[Text] Walter Zepf of Constance is taking the tiger out of the tank and is filling up with beets instead: the lubrication technologist brews up a mixture which allows gasoline to be replaced by alcohol as a motor fuel. Such a high-percentage solution to the oil crisis can be obtained as "methanol" from coal or as "ethanol" from fermented plants--sugar beets, barley and corn.

Enriched with 6 to 8 percent of Zepf's additive--the recipe for which the meticulous Swabian worker keeps secret because the patenting process is still incomplete--firewater stimulates the ordinary automobile engine to even more oomph than gasoline. The technical changes are limited to incorporating bigger fuel injectors in the carburetor. STERN ascertained a performance increase of three horsepower on the dynamometer for a Volkswagen Derby--along with accompanying phenomena of a pleasant nature: instead of gasoline exhaust, the odor of pure fruit wine poured out of the tailpipe.

It is certainly not a new notion to run motors with alcohol instead of with expensive gasoline. But in practice it was previously possible only to stretch out the commercial spirits with alcohol, because engines refuse to take in fuel when pure methanol or ethanol is used. Experts are not counting on the solution of this technical difficulty before the 1990's.

A 4-year experimental programm is just now being prepared in the Federal Ministry of Research. 100 motors were ordered in Wolfsburg which digest pure methanol and which are to be built into Volkswagen Rabbits and Dashers. It is palnned to test their day-in, day-out suitability in Berlin city traffic.

Walter Zepf is far ahead of this. His motors run on alcohol already. Also the consumption of additive--according to Zepf--amounts to 30 percent at most, compared with gasoline. And the extra costs are kept moderate: the manufacturing price (without taxes) for alcohol plus Zepf's mixture runs to 30 German pfennig per liter (27-33 pfenning per liter for gasoline).

Zepf, who is self-taught and who became a lubrications expert in the German Air Force in World War II, long ago made a name for himself in the field of synthetic oils. He delivered "tailor-made" lubricants for conditions of extreme stress to famous German auto manufacturers such as Daimler-Benz, as well as to the American engine manufacturer Pratt & Whitney. And for years the escalators of the Munich transit system have been running like greased pigs with Zepf's synthetic fat.

Up to now, however, neither officials nor energy big wheels have taken an interest in the experiments of the three-man concern in Constance. In Land ministries in Stuttgart, Zepf's attempts to draw attention to his developments broke down in the jurisdictional confusion. Nor was there as yet any reaction from the Federal Ministry of Research.

The Rhodesians are shrewder. This nation, which suffers from a chronic deficiency of oil, might have the right climate and enough open space to manufacture ethanol. The Africans are presently negotiating with Zepf about delivery of his product.

In the FRG, on the other hand, it might be possible to produce methanol--the necessary raw materials such as coal, lignite or natural gas are in fact available in abundance. At this time 1.27 million metric tons of methanol are produced in the FRG each year, almost exclusively for petrochemistry. Factories for an annual production of up to 6 million tons are being planned. Nonetheless, if it were desired to replace completely the 23 million tons of auto fuel consumed in the Federal Republic in 1978, billions of marks in investments would be necessary.

When an Arab oil-producing country offered him 2 million marks last year for the formulation of his mixture, in order to keep it under wraps, Zepf demurred: "I just want to make a contribution to overcoming the energy crisis. But when I see how the government officials behave, I often think we have no energy crisis at all."

8838
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FEDERAL REPUBLIC OF GERMANY

USE OF HYDROGEN AS AIRCRAFT, MOTOR FUEL STUDIED

Hamburg STERN in German 20 Sep 79 pp 246, 250

[Article by Peter Thomsen: "Fuel From the Ocean"]

[Text] The first airplanes for the postpetroleum age are already taking shape on the drawing boards. They are to be fueled with hydrogen.

Above the clouds, where freedom presumably has no bounds, it will soon smell like grandma's laundry room. For the airplane of the future will go up, up and away, without being kerosene-fired. In the postpetroleum age hydrogen is to fuel the jets, and instead of soot and smoke only hot steam will be blown into the air.

For 4 days last week, scientists and engineers from Germany and from abroad reflected on the possibilities and problems of such a flight from oil at the German Research and Development Institute for Air and Space Travel (DFVLR) in Stuttgart. Summary: difficult, but possible.

As a matter of fact, already in the fifties, the U.S. Air Force experimented with hydrogen, the lightest element: It rebuilt a two-engine Canberra bomber for hydrogen propulsion and flew it for years. The advantage: hydrogen contains three times as much energy per kilogram as kerosene and is available in the oceans in any amount desired.

Water is separated into its two components: hydrogen and oxygen; the hydrogen is burnt in the engine and in the process recombines with oxygen to become water once again. The cycle starts again at the beginning. The combustion product is at the same time the raw material. It is, however, difficult to set the cycle into motion, it takes at least as much energy to separate water into its components as is later on freed in the combustion of the hydrogen.

Several processes are possible, but experts regard the method, familiar to students from chemistry instruction, viz., electrolysis, as full of possibilities for the future. In this method, electric current is sent into water and separates it into the gases of hydrogen and oxygen.

Hydrogen production for a single trans-Atlantic flight of a jumbojet would consume at least 1.5 million kilowatt hours of electricity. An airport like Frankfurt, at which the present daily ration of 5,000 tons of kerosene would have to be replaced by 1,500 tons of hydrogen, according to calculations by the DFVLR, would have to add four power stations for the production of electricity--at present still uneconomical, but with constantly rising oil prices not a remote utopia. Transportation and storage remain a problem. For it is only in liquid form that hydrogen becomes fuel. But the base condenses only at a temperature of 250 degrees below zero and even this it is comparatively voluminous: The tanks would have to be four times larger than in conventional aircraft although the fuel weighs only one-third.

These properties have led to peculiar airplane designs. Since the wing tanks commonly in use today cannot hold the large volume of hydrogen, the designers drafted clumsy tank gondolas for the wings. But their air resistance allows only a leisurely tempo. The future, therefore, belongs to the fuselage tank.

This design calls for the elongation of the fuselage of a Boeing 747, for example, by 10 meters in order to create space for two tanks behind the cockpit and in front of the tail. The designers of Boeing and Lockheed even turn the disadvantage--that this design does not allow for a passage between passenger section and the cockpit--into an advantage: blackmailers, they say, would find it much more difficult to hijack an airplane.

At most they are worried by the close proximity of the tanks to the passenger compartment. For in the case of an accident the richness of hydrogen would have catastrophic consequences: Mixed with oxygen, hydrogen turns into highly explosive oxyhydrogen. And if worst comes to worst, hydrogen can not only ignite in a flash, but even "detonate"--a process which is otherwise known only with explosives. The higher tempo distinguishes the detonation from the comparably mild explosion: the line of fire moves with ultrasonic speed through the gas mixture. The entire destructive power is freed all at once.

For this reason some airlines are opposed to hydrogen. They place their faith in the distillation of fuel from coal. But Prof Walter Peschka, one of the hydrogen experts at the DFVLR, regards this hope as the wrong way to go: "The production of synthetic fuels from coal in the final analysis takes place through the accumulation of hydrogen on carbon. Why, then, not simply take it as fuel?"

That the DFVLR already does--even if only on an experimental basis and not yet in high altitude flights: The Stuttgart engineers rebuilt a BMW 520 to run on hydrogen. The reequipment did not pose a problem. Already the first Otto engines 120 years ago ran on gas. More difficult was the construction of the tank, which at a temperature of 250 degrees below zero must isolate the hydrogen from the warm environment and at the same time protect it in the case of accidents. At 40 kilograms, it turned out to be clearly heavier than conventional car tanks, and at the same time it holds only 10 kilograms of hydrogen which, however, because of the higher energy content and greater efficiency go as far as 50 liters of gasoline.

Refueling is also more complicated than at a gasoline filling station. For the air in the tank contains explosive traces of gas. They must be pumped off by a second hose and collected, and the refueling hose itself--made of flexible metal--must withstand 250 degrees below zero.

The punctilious Swabians have solved these kinds of problems on the DFVLR grounds in Stuttgart-Vaihingen. They run a hydrogen fuel stationfor cars there--the only one in the world.

8970
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FEDERAL REPUBLIC OF GERMANY

NEW DEVELOPMENTS IN AUTOMOTIVE ELECTRONICS OUTLINED

Hamburg CAPITAL in German No 9, Sep 79 pp 170-177

[Unattributed article: "Electronics Taking Over the Car"]

[Text] More economical engines, less environmental pollution, and more comfort--all this, car designers are doing less and less with the traditional means of mechanics; the car of tomorrow is now fashioned by electronics.

Ali and Lisa

Over a cup of coffee and pastry on the top floor of the VW Development Center at Wolfsburg, development boss Professor Ernst Fiala makes some seemingly commonplace statements. "The car," he says, "will continue to run on four wheels and will be powered by a combustion-piston engine." Fiala's colleague Dr Karlheinz Radermacher, of Bavarian Motor Works, also sees the "revolution in electronics" coming our way. But in addressing himself to this topic, the man from BMW [Bavarian Motor Works], who is responsible for research and development, almost waxes poetic: "The development of electronic structural elements--semiconductors and microprocessors--has made fascinating progress in terms of cost and dimensions."

Until now, the machine-builders ran the show in the design offices of the auto factory. But today there is another species of engineers who assume more and more significance; they are the electronics engineers. One of them is already the top designer at Daimler-Benz; he is Professor Werner Breitschwerdt.

There would seem to be hardly any limits to the possibilities of modern electronics, characterized above all by the so-called microprocessors. "Anything can be done," the components makers announced proudly at every opportunity. They figure that they have just about unlimited chances for new sales outlets because no auto maker can overlook the technical possibilities of electronics. Just about all semiconductor producers in the meantime have established development divisions which are concerned only with the utilization of their products in the difficult field that comes under the title of "automobile." The work is difficult because electronic instruments are exposed to special stress in the car: Considerable temperature fluctuations, the effect of moisture, humidity, and salt or continuous shaking and shocks require more from the inventors than, for example, an electronically controlled bathroom scale.

In spite of all of the difficulties which the automobile creates for the electronics experts, the car's future has already begun. "Intelligent" microprocessors can even today optimize gasoline injection and ignition. There is a broad range of innovations which not only make driving cheaper but also considerably more complex and those innovations have left the drawing board a long time ago.

Auto suppliers recently have been joined by a series of well-known names: The Siemens Corporation, perhaps, or the E. Merck Chemical Corporation, AEG [General Electric Company]-Telefunken, and ITT or Texas Instruments supply countless structural components which have already passed their trials.

It is a good thing for the auto buyer of tomorrow to realize that the additional comfort will not cost him more money. "It is to be expected," says BMW's Radermacher, "that a transistor operation by the end of this decade will cost about 1/100 of a Pfennig. In other words, 10,000 transistor operations will cause an expenditure of only DM1." Each of these operations 10 years ago still cost DM2. This price reduction is the consequence of constantly refined technology.

"On a chip with a size of 5 square millimeters one can place 100,000 transistors and this development is not over yet," Radermacher said enthusiastically. It is no wonder then that cost-conscious car designers want to build more and more of these reasonably-priced parts into their cars. Dr Karsten Ehlers, head of the main division for vehicle electronics design at VW in Wolfsburg, observed: "In 1978, electronics accounted for 2 percent of the net production costs of a vehicle; in 1983 the figure will be 4 percent and in 1988 about 8 percent."

Through electronics, engine designers hope to get not only more comfort for the driver but above all improvements in gasoline consumption and exhaust volume. Measurement and regulating processes, such as they constantly take place in connection with the control of the moment of ignition, are ideal for electronics. The top-line cars have for a long time been equipped with gasoline [fuel] injection. Of course, mechanical systems still prevail here but electronics keeps gaining ground.

Electronic ignition is already the rule in cars in the higher price ranges. In the future, it will be combined with electronically controlled injection. The digital engine electronics system developed by Bosch has a higher "degree of intelligence" than the hitherto separated electronic systems alone because of a series of microprocessors. The system, called Motronic, does a considerably better job in adjusting the composition of the gasoline-air mixture, on the one hand, and the moment of ignition, on the other hand, to the complicated conditions in the engine, better, that is, than would have been possible with two separate systems. The consequence of that is that you get more performance at less gasoline consumption. The Motronic system, which experts have hailed as being sensational, "depending upon the marginal conditions, the driving cycle, and the comparison base," introduces "consumption gains of between 5 and 20 percent" (Bosch). The new model 732i of BMW is the first vehicle of this kind in the world to be equipped with this little miracle box.

But the Motronic system is only the tip of the iceberg which is visible today in motor electronics. For the coming years, drivers can expect a whole range of further innovations. Thus we can expect that, in the near future:

Simpler and thus cheaper systems will replace the current ones in gasoline injection;

Electronic iginition will be standard in every car;

Injection or carburetors will be controlled by the composition of the exhaust gases;

The Diesel injection pump, so far, a conventional machine-building element, will be electronically regulated.

At the VW plant, for example, the electronic carburetor will go into series production already next year. In 1980 likewise the people at Wolfsburg want to install the electronic ignition system into their cars in combination with a "digital idling stabilization device." Both of these parts have already been installed in the new VW-transporter. Just one year later, in 1981, VW will start series production of gasoline-injection electronics and by 1985, the electronically controlled Diesel injection pump is to be ready for installation.

"In the beginning," Ehlers, of VW, recalls, "electronics was used primarily to replace precision mechanics. But it can do much more." Solutions, such as Motronic, indeed could not be implemented in purely mechanical ways.

This applies also to novel engine concepts such as the cylinders that can be turned off; if, while driving slowly, one needs little output, then a part (in case of six cylinders, perhaps three of them) will be shut down. The rest of the engine runs at higher efficiency and one can save 15 percent fuel. Ford, in the United States, and BMW are already running prototypes of such "research motors" which of course are "still far away from series production," according to Radermacher, of BMW.

Electronic gear control is considerably closer to the goal. The automatic gear of the future will have more speeds than today and it will also be adjusted according to consumption-oriented viewpoints. Porsche, for example, suggests an automatic five-speed gear with two mechanical clutches for his car of the future, the Model 995, which is presently being developed as a research project by direction of the Federal Ministry of Research and Technology. As customary in the case of the automatic gear, it can be switched without the driver having to take his foot off the gas pedal but it prevents the energy losses of the still customary hydraulic torque converter. Motronic, for example, supplies the necessary control impulses at the same time.

Today, the microcomputer is already involved in braking. The top-of-the-line models of BMW and Mercedes can be equipped with the ABS--the electronic antiblocking [jam-proof] system as an option. Of course, the current additional cost of about DM2,200 would prevent any wide use of this option. Persons purchasing cars in the lower price categories must not for the time being hope that they will soon be able to avail themselves of this safety system.

On the other hand, car owners in all categories will in the future find themselves facing an improved dashboard. VW in Wolfsburg today already called it the FIZ (Driver Information Center) and indicates its versatility through the name selected for it. Outwardly there will be hardly any changes because "we, here at VW, are not advocates of digital display" (Ehlers) because numbers instead of the customary styles cause more confusion and provide less information. VW and VDO /Veigel-Deuter-Ctag/ are therefore taking a different tack: In the future there will not be any more needles; instead, a circular sector will become visible and it will grow as the reading value grows. The development experts believe that this will be easier to perceive than a number. In the United States, the engineers are thinking along different lines. There they already have big digital numbers also for the tachometers.

Less important readings, of course, such as the oil pressure, the water temperature, the tank content, possibly also the engine revolutions, will later on appear as numbers likewise hereabouts. In the future, the dashboard will be decisive as the most important part of the interior appointments in determining the sales success of a particular model. "While cars are being increasingly adjusted to the air resistance minimum in terms of the external shape and are therefore also becoming increasingly similar to each other," comments VW electronics expert Ehlers, "extravagant equipment and therefore also much electronics are assuming greater significance. During the next ten years, we will witness the battle for the customer inside the car and, here again, especially along the dashboard."

The currently customary secondary dials and lights will yield to something newer. Instrument makers and vehicle electronics experts are tinkering with newfangled indication systems which do not supply the driver with information on car defects when it is basically already too late to do anything about them.

A central warning system points the way to the future; it was developed among others by Hella and turns three different warning lights on:

Sustained yellow light means "get gas"; that means not only the content of the tank but also the oil level, the bulbs, the cooling water, and the windshield spray water level.

A sustained red light means "shop"--for example, if there is a defect in the light machine, when the brake linings are worn out, or when the brake fluid level has dropped.

A flashing red light, in the Hella model, means "stop"--when the cooling water is overheated, in case of deficient oil pressure, or if there is no brake fluid.

Of course, the warning light, which can be supplemented by a buzzer, is not the end of the story. In addition, the real cause of the tro ble is indicated on a small panel. The incoming signals, arriving from the central computer, are arranged and classified by the microcomputer. The driver is then warned in a graduated fashion; he need not constantly keep his eyes on scales or dials or numbers. VDO is likewise working on a similar system.

BMW is working on check-control in the model 6 and model 7 types, showing an approach in that direction; in its model 928, Porsche already has a central warning system which--in contrast to BMW--works without the driver having to push a button. Such built-in control systems will be standard in the future. The advantage is that they permit longer car inspection intervals. Eberhard Zuckmantel, head of future developments at Hella, considers a central warning system above all to be a game in terms of passenger safety. One development item by Bosch fits in rather well here; it involves the electronic surveillance of tire pressure.

About a year ago, Chrysler-Simca (today, Talbot) introduced a so-called on-board computer in its Horizon model. In the United States, the first models of this kind of instrument came out already in 1977. In the Horizon it indicates not only the time elapsed since departure but also the mileage, the average speed, the gallons of gasoline consumed, and the average consumption for the distance covered so far. But the most important information item--the momentary consumption in liters per 100 kilometers--it does not provide. The trip computer, introduced by Cadillac in 1978, cannot provide this useful and psychologically valuable information item. Together with Siemens, BMW developed an on-board computer which also indicates the momentary consumption. That of course will be reserved in the beginning only for persons buying the big "7" models--of course at extra costs.

Along with this innovation we also have the first criticism of such "gadgets." "Readings as to average speed, the distance yet to be covered to the destination, and funny things like that," reports ADAC, "can be considered more in terms of the satisfaction of the need to play around and less in terms of required information." People who have come up with such severe judgements include Ernst Gundel, the main division chief for technical services in Germany's 6-million member Auto Club, and Eberhard Twiehaus, head of the transportation sector at ADAC headquarters. In spite of all criticisms, on-board computers will during the next several years undoubtedly become a big help to drivers and an essential selling point in the auto industry.

Electronics will also move into areas here which are not immediately visible to the driver:

The regulation of heating and air conditioning systems, whereby we will at last have heating systems which work independently of the speed;

The Tempomat which will keep an adjusted speed constant;

The Crash-Sensor which, in case of an accident, will improve the effect of seatbelts by tightening them up due to the firing of a propulsion charge;

Interval warning instruments telling the driver--as a function of the speed--that his interval to the car in front is too short, thus reducing the danger of rear-end collisions;

Electronically controlled instruments which will help the driver to assume the best possible sitting position.

Sometime later, perhaps in 1990, electronics will also make most of the electrical cables in the car superfluous. The "cable tree," which today consists of between 300 and 600 meters of expensive copper wire, will be replaced by a simple ring circuit which gets its commands from a central control point.

Electronics soon will no longer change the car itself but will also make it easier to handle the car. Here, the car radio will in the near future assume an even more important function than today. The manufacturers are tinkering with prototypes which have no buttons any longer but which can be turned on by voice command and which pick out certain radio stations by themselves. The idea can be transferred to the dashboard: The "talking dashboard" is no figment of the imagination ever since we have had talking electronics in computers.

The directional arrow, which lights up at the dashboard at every intersection or fork and which tells the driver which way to go likewise is no longer utopia. "The VW plant," says Dr Walter Zimdahl, chief of the vehicle electronics department in Wolfsburg, "together with Blaupunkt, developed a guidance and destination control system for drivers. As a consistent extension of the traffic radio system, this system makes it possible to transmit information on traffic signals, traffic obstacles, or weather conditions to drivers with accurate data in terms of place and time."

The VW plant calls this system LISA (Guidance and Information System for Drivers) while Blaupunkt calls it ALI (Driver Guidance and Information System). Before starting, the driver punches his destination in on certain keys. The instrument passes this destination code on when driving over induction loops which are located on the road at intersections and forks. While driving across them, the instruction comes back which causes the directional arrow to light up. In case of traffic jams, a detour is indicated automatically. ALI and LISA are based on induction loops here which are being put in on the superhighways anyway for the purpose of recording traffic data.

"We believe," says VW development boss Zimdahl, "that such systems will be in widespread use by 1988." He estimates that the cost will be astonishingly low: About DM350 million to equip the superhighways and only about DM200 for each vehicle. A large-scale experiment is designed to test the suitability of this system in autumn of this year in the Ruhr region.

Blaupunkt however has also set itself some high goals for urban tafffic: EVA, the electronic traffic pilot for drivers, is a real miracle. It contains an electronic city plan memory storage unit, in which all street intersections are stored along with the pertinent routes. Blaupunkt wants to start developing this item already in autumn of this year.

Looking at it this way, driving will become mere child's play.

5058
CSO: 3102

FRANCE

PROBLEMS IN DERIVING ENERGY FROM BIOMASS DISCUSSED

Paris LE PROGRES SCIENTIFIQUE in French Jan-Feb 79 pp 52-57

[Text] Under the sponsorship of the Committee on Energy Use of Farm Wastes (VEDA), two days of study and analysis were held in Paris on 13 and 14 March 1979 by the Association for Industrial-Agricultural Development, with Secretary of State to the Prime Minister in Charge of Research Pierre Aigrain presiding.

Mr Andre Gac, chief of agricultural engineering at the Department of Water Resources and Forests, and president of the VEDA Committee, summarized the conclusions of these days of study and defined the prospects for this activity in an address the text of which is reproduced below.

"The role of the Committee on Energy Uses of Farm Wastes has been to study every system, whether new or not, capable of transforming agricultural refuse into usable energy. The term refuse is viewed in a broad sense, since it involves not only purely agricultural activities but also those in forestry and the farm-food industries.

The Committee was established in 1975 to function for a period of three years. It has been given three allocations of two million francs, thanks to which it has proposed 53 research contracts. As the financing supplied by the DGRST [General Delegation for Scientific and Technical Research] only partially covers the real cost of the activities, it can be estimated that the overall cost of the research effort sponsored directly by the Committee comes to about 25 million francs. But by its very action, the Committee has drawn the attention of laboratories and industrialists to certain subjects and inspired other research undertakings.

Moreover, the Committee has attempted not only to encourage and coordinate research and to follow their progress regularly, but also to evaluate the difficulties encountered by the teams and to reorganize its program of bids every year as a function of the information obtained from the contracting parties.

If some studies are still in the research stage, others have led to specific proposals for industrial development or pre-development. Also the Committee deemed it essential to encourage the generalization of the results obtained as well as providing its views concerning the energy potential of different farm production systems and, in a more general way, the energy-producing systems which put biological processes to work.

The purpose of the days of study has been precisely to take stock of the research activity pursued within the framework of the VEDA, and to set forth its conclusions.

The Committee chose as the subjects for the days of study the three main themes in its program, to wit:

Evaluation of the energy resource contained in farm and forest products;

Bacterial methanogenesis; and

The combustion and gassification of cellulosic and ligneous products.

It required a number of specialists, some of them moreover members of the Committee, to draft a summary in synthetic fashion of the results obtained by the contractors.

On the basis of these reports and taking the discussions to which they gave rise into account, what is needed now is to establish which of the energy bioconversion systems would be most promising in the short, medium and long range, and which, moreover, could contribute to preserving the fertility of farm and forest soils, increasing the profitability of farm operations and industries, or again play a role in protecting the natural environment by reducing pollution and nuisances.

The Quality of Energy

By way of a preliminary remark, it would be well to recall the choice made by the Committee concerning the energy which should result from the use of this waste.

The final form in the bioconversion chain should be a fuel or hydrocarbon compound the use of which can be delayed in time and which is capable of supplying heat at a temperature high enough for future conversion into work, with an acceptable yield.

The quality of the energy from agricultural and forest wastes should be comparable to that from fossil fuels, and is thus not comparable to that of thermal waste from industry (for example, the hot water from nuclear power plants) or again that of planned systems to utilize the rays of the sun.

Resources and Biomass Energy

The vegetable products from farm and forest which together constitute the biomass are a substantial reserve of raw materials which, depending on their composition, can be used for:

Human food;

Animal feed;

Various industrial activities;

The preservation of the natural environment and the improvement of living conditions;

Maintaining the fertility of farm and forest soils; and

The production of energy.

Biomass, which once supplied almost all the energy needed for human activities, has been gradually replaced by fossil fuels, because the latter were more convenient to use and very clearly less expensive.

The crisis in oil product supply, altering economic factors, brought the advantages of biomass, the sole renewable source of carbon, to the fore again.

But whatever the prospects for energy production from biomass, it is important first of all to maintain the balance established among its various use chains.

The resource which is immediately available for energy production is made up of refuse from agriculture and forestry operations, that is to say substances which to date were abandoned or destroyed. But not all waste is of equal interest. The types which are most abundant and best suited to use as a fuel because they are dry are straw and wood (20 to 25 percent of the wood cut is presently left in the forest). The following general guidelines can be derived from the studies, basically of an economic nature, which have been made.

The refuse left on site could not be taken out in its entirety advantageously, because, among other things, of the need to maintain a rich humus. It is necessary to undertake a precise evaluation of the percentage of the waste which is really available. For example, for straw, this available volume is estimated at four or five million tons, in other words 20 percent of the total straw production, which corresponds moreover to nearly two million equivalent oil tons (TEP).

The majority of this waste is scattered, such that "deposits" are poor. This is why local circumstances exert a great influence on the profitability of using this refuse. In particular the distance between the collection point and the heating site should be short. Depending on the conditions of collection and the use, the price of straw fuel could range from 3 to 10 centimes per kilogram. Thus it would be desirable to undertake a precise analysis, adopting the methodology developed for straw, for each type of waste and production zone, of the economic and agronomic conditions of the energy chain, and to inform exploiters of the provisions and procedures allowing profitable utilization of some of their wastes by means of this chain.

The use of waste massed together, either because it is the refuse from a given industrial activity (that of sawmills, for example), or because its removal is essential (maintenance of fire breaks in the forest), or again because industrial farm refuse is involved, is of greater interest economically and thus should have priority development.

One of the serious difficulties to be overcome to ensure the energy use of waste involves the farm and forest machine sector. For example, in the case of forest production, the removal of branches required by the silviculture projects could be done more cheaply if the wood could be utilized. In addition, the forests could be made more productive through the more rational exploitation of brushwood. But whatever the justification for gathering up waste in the fields or the forest, it is almost always discovered that the proper machinery does not exist or that that currently in use would require conversion in order to reduce the financial cost and energy expenditure entailed by this "harvesting." For straw, the collection should be coordinated simultaneous with the grain harvest. Similarly, the quantity of straw could be increased at no cost by 100 kilograms per hectare per year, i.e. by about 15 percent, representing 40 kilograms of fuel per hectare per year, by cutting the stalks closer to the ground. Comparable examples could be cited for the forest.

French construction is handicapped both because of the state of the market and because of the harsh competition which it encounters. It would also be desirable if exceptional initiatives were put to work to speed up the perfecting and industrial development of new machinery.

In view of the energy potential of certain wastes, it would be possible to seek to increase the quantity. For example, by genetic selection, varieties of grains with long stalks could be developed, but these varieties would doubtless be less hardy than the present ones, in terms of disease and wind damage among other things. Thus such a step would overall by somewhat inefficient. Waste can become a recoverable byproduct, but its profitability will remain limited compared to that of the main crop even if it contributes to increasing the overall advantages of that crop to the extent that the yield of the majority of crops will increase still further in the years to come. On the other hand, there are more attractive prospects in the medium and long range for "energy farming," i.e. the cultivation of systems and techniques providing large quantities of vegetable matter (biomass) in a short time, while depleting the mineral elements and nitrogen as little as possible. Forestry experts estimate that the present French production of 30 to 40 million cubic meters per year obtained from 14 million hectares of wooded land could be almost doubled by planting suitable terrain to timber, caring for the forests and planting the species best adapted to the goal sought. For the purposes of energy production, a closely planted poplar stand harvested every four years would be an example of a system designed solely for the production of biomass energy. Another example often cited is the production of water hyacinths (130 tons per hectare converted into methane by fermentation). One can imagine other energy-oriented ventures, such as the cultivation of velvet grass, a gramineous plant with a very long stem (1.20 meters), the marsh reed, Arundo donax, etc.

Also, since the profitability of utilizing waste as well as that of energy agriculture has not as yet been accurately established, it would be well to extend the agroeconomical studies begun by the Committee to the whole of the biomass energy field.

Methanogenesis

The methanogenic fermentation of moist agricultural or industrial organic wastes, manure piles and liquid manure, was inevitably one of the subjects taken up by the VEDA Committee, because this process underwent a certain development in Europe in the course of the last world war, because currently a number of installations, very primitive and unproductive it is true, are being used in the countries in the process of development and in particular in the Indies, and, finally, because continuous installations are operating under satisfactory conditions at the scrubber stations. Moreover, from the agronomic viewpoint, this procedure represents an attractive compromise between the production of a gas fuel and production of high-quality fertilizer. Finally, it contributes to reducing nuisances and to preservation of the environment.

The purpose of the contracts was to specify the conditions for launching and pursuing fermentation, to develop efficient and profitable installations, to improve the efficiency of methanogenesis and, finally, to define the relative importance of the herd and gas production.

Without reiterating the results reported in the course of the symposium, some points merit special stress to suggest the prospects for development and the guidelines for research.

If the continuous procedure, which has been perfected, can be used for liquid manure as well as generally speaking for any diluted carbonaceous waste, the discontinuous method, which still needs to be improved, is of special interest for the processing of strawy manure and substances containing little moisture and suitable for compacting. It would in fact be uneconomical to dilute these substances and then have to treat the effluent before releasing it into the environment.

The technology of discontinuous fermentation is now more or less well known. On the other hand, new fermentors need to be designed. They must be impervious, easy to load and, above all, to empty, using mechanical means. They must have effective heat insulation, and additionally, it must be possible to equip them with economical and reliable heating mechanisms. It is essential to maintain the temperature of the mass at at least 35 degrees centigrade, or a substantial drop in microbial activity will occur, and it can only be re-established with some delay (about a week) after reheating to 35 degrees centigrade. Ordinarily, a part of the methane production is burned when the outer temperature drops, such that the overall energy balance drops and may be canceled out. Now the fermentors could be heated to 35 degrees centigrade, which is a moderate temperature, with a system such as a solar collector. Efforts thus should be undertaken to ensure the designing and development of fermentors and their heating.

There seems to be no specific need for machines for the loading and emptying of the fermentors. The present equipment for transporting solid and liquid manure should be usable. On the other hand, the compacting facilities for fodder silos will have to be adapted for compacting manure in fermentors. This problem should not pose any serious technical difficulties.

In view of the present stage in the development of technology, it can be presumed that profitable equipment can be installed, if certain limitations are taken into account, in the short term, in particular after industry has produced efficient fermentors. For the heating of a farm home (power of approximately 500 thermies per day), a herd of 40 to 50 cattle or 800 to 1000 swine or 600 to 700 sheep is needed. If one wanted only to produce gas to cover household water heating needs, the installation would be too costly. It would be better to have recourse to another method such as solar heat collection. Cattle and sheep raising enterprises seem better suited than swine raising to the production of methane gas, for the animals live outdoors in the warm season. Thus a certain balance is established between gas production and energy needs.

For obvious safety reasons, the compression of gas on the farm itself cannot currently be planned with a view to its storage or supplying automotive engines (for example tractors). If there is a surplus of methane, in summer in particular, it could be used for certain farm activities (drying fodder or grain, supplying a generator set, etc).

If we could foresee that the development of the methanogenetic chain would begin in the near future, the technology utilized could be further perfected. In fact, considerable progress can be expected. In the medium range, a consistent and interdisciplinary program of research should be established with a view to the better understanding of the basic biochemical mechanisms and the microbial ecology of methanogenesis, in relation to the designing of fermentors.

On the other hand, it is known that the breakdown of cellulose, of which special studies have been made, occurs in three stages: the production of fatty acids, sugars and alcohols, then the formation of acetates, formates, hydrogen and carbon dioxide, the precursors of the methane, and finally, methanogenesis as such. Microbial strains for which the optimal temperatures differ correspond to each stage. Given the complexity and the interest of this problem, a long-term research program should be established to look into the following aspects, among others:

1. Establishment of a catalog of strains of microorganisms playing a role in methanogenesis at all levels;

2. Development of techniques for isolating and preserving these strains in pure culture;

3. Study of the syntrophic relations among the various groups; the energetics of growth of microorganisms implanted in pure and mixed cultures;

4. Mass culture of pure strains isolated, essential to biochemical studies;

5. Biochemistry of the breakdown of polymers (cellulose being only one special case);

6. Biochemistry of the synthesis of intermediary organic compounds: acids, alcohols, etc.

7. Biochemistry of the transfer of hydrogen: synthesis and oxidation of the molecule.

8. Biochemistry of methanogenesis: fixation and reduction of carbon dioxide; conservation of energy.

Item 7 merits special mention because it relates to research on solar biocombustibles designed to produce hydrogen through the photolysis of water.

Finally, experimental studies on the rational use of fermented solid and liquid manures should be pursued more extensively. The interest of these studies in terms of the maintenance of soil fertility, the reduction of synthetic fertilizer needs and the elimination of certain nuisances is obvious.

Pyrolysis and Gassification

Until the end of World War II, the methods by which wood was used for energy purposes were:

Total combustion;

Carbonization to produce charcoal and rich gases; and

Gassification and the production of a gas fuel used in particular to operate engines.

As this was the case for methane, these methods were gradually abandoned in favor of fossil fuels. The VEDA Committee returned to these same methods as a subject of study, but extending them to all ligneous and cellulosic products.

For combustion, a boiler adapted to burning straw pellets was developed. It proved to have great flexibility. It was used for two seasons for the heating of greenhouses. Its yield, between 50 and 55 percent, is relatively acceptable but could be increased by certain improvements, which are already being planned.

On the other hand, encouraging results were obtained in the processing, in expensive fashion, of rough-cut straw to feed boilers or gas generators.

Preliminary research of an analytical nature on carbonization made it possible to establish the suitability of various domestic and tropical species for the production of charcoal, pyroligneous products and gas. It appears that on the whole there are no substantial differences in suitability among the various forest species. However the highest yields in charcoal are obtained from the woods rich in lignin (37 percent of the dry wood), and in pyroligneous products, from the species rich in cellulose and hemi-cellulose (51 percent of the dry wood). In particular, it was established, pending confirmation, that methanol could be obtained from cellulose and not just from lignin. Finally, the gas yield depends relatively little on the chemical composition of the raw materials.

An interesting possibility for utilizing charcoal involves converting it in a gas generator such as to obtain a gas fuel usable in a stationary or moving engine (farm tractor, for example).

For gassification, it was demonstrated that the optimal yield is obtained between 900 and 1000 degrees centigrade and that the presence of water substantially improves the rate of gas formation.

One path of research recommended by the Committee is the building of gas generators adapted to the use of various types of plant waste in pellets ranging from sizable to very fine. A 200 kWe gas generator with a fixed bed adapted to large pieces of wood was built and provided interesting results in October 1978. Also a pilot 500 kWe model was put into production. The advantages of this equipment are reduced bulk, in a ratio of one to three, and lower production costs.

On the other hand, for less bulky waste, gassification with the classic materials requires prior pelletization. This operation can be avoided with a gas generator of the suspension type, a study of which was also undertaken within the framework of the Committee's work. The present prototype, with a power of 300 kWe, can be linked with an engine through a scrubber, to eliminate all residual solid particles. This engine can operate an alternator; the yield is one kWe per kilogram of straw. In addition the ashes are recovered in powdered form and can thus be recycled into the soil without grinding.

Finally, for the types of wastes in rather fine pellets, a third type of gas generator, the VEDA Committee has undertaken a study of a third type of gas generator. Based on an adaptation of the rotating furnace, this generator has just been produced but has not yet been put into use.

Finally, the activity of the Committee in the short run ended with the designing and production of new equipment, in particular the original gas generators expected to be subjected to certain industrial development, for the national market, and above all for the markets of the countries in the process of development, whose ligneous and cellulosic resources are substantial.

Three other lines of research in the medium and long range also pertain to ligneous and cellulosic products and should be given priority in research effort:

Carbonization yielding charcoal, gas and pyroligneous products rich in various chemical compounds;

Production of gas by synthesis usable for the production of liquid fuels, such as methanol; and

Research on chemical processes to preserve certain vegetable polymers for use for purposes other than energy production.

The vegetable compounds and in particular those found in wood are in fact a substantial resource of more or less complex molecules, some of which could be better utilized as raw materials for industry.

For example, the potential of lignin is still little understood. This substance, which is lost in the manufacture of paper, should find new applications, in particular in the chemical industry.

Other Energy Processes

Other energy processes were contemplated by the Committee, alcoholic fermentation in particular. In fact, setting the case of sugar cane aside, the overall energy balance from this operation is negative: the quantity of energy recovered in the form of alcohol is less than that of the fuel consumed by the production process as a whole. This is why the Committee deemed the preliminary perfecting of techniques for separating alcohol, more economical in fuel, necessary. One of the methods is heating by collecting the rays of the sun. The Committee assigned a contract in this connection to the DGRST, with a favorable recommendation. Another research path approved by the Committee involved obtaining a juice from deproteinized lactose with an alcohol content of about 10 percent by ultrafiltration over a period of between 24 and 48 hours. Although this work is still incomplete, the first results justify the hope that the procedure will prove of a certain economic interest.

Other processes for breaking down wastes such as to liberate heat have received little study (for example, the aerobic fermentation of wood scraps). Although the energy recovered is heat at a relatively low temperature which cannot be stored, these methods may be of a certain practical interest for meeting the heating needs of agricultural operations. For this reason a systematic study of the procedures would be desirable.

Conclusions

In addition to the technical conclusions which have just been set forth, the Committee also formulated the following general recommendations:

1. The unsuitability or inadequacy of equipment and machinery is a permanent hindrance to the implementation in practice of the results of studies on the energy uses of farm and forest materials. There is an urgent need to establish within a short time a real campaign of incentives for the designing and production of the machines needed for the utilization of these results.

2. The activities financed by the credit made available to the VEDA have not been completed. They must be carried through in one way or another if the efforts made to date are not to run the risk of limited usefulness.

3. It is now well established that certain farm and forest wastes and products can contribute effectively to resolving the energy crisis, provided there is proof of the political willingness to grant over a long period the means essential to proper research on biomass energy, and to the development of that research to the point of obtaining liquid fuel in the future. What is at stake is a potential annual production of 7 million TEP in 1985 and 10 million by the year 2000.

4. However the establishment of such a policy presumes on the one hand an understanding of and respect for the specific limitations due to the biological nature of the phenomena in question, and on the other hand, respect for the necessary balance among the various goals of agriculture: food production, farm industries, soil preservation, development and protection of rural space.

5. Finally, because of the foreseeable development involving the occupation and use of the territory as a result of the scientific gains which cannot fail to be achieved in the understanding of the mechanisms of the formation, transformation and breakdown of ligneous and cellulosic substances, it would be well as of the present not only to develop the methods for utilizing farm and forest refuse but also to plan for the establishment of new agricultural activities serving essentially industrial and energy-producing purposes."

5157
CSO: 3102

ITALY

SOCIETY'S TECHNOLOGY INVESTMENT POLICIES OUTLINED

Milan CORRIERE DELLA SERA in Italian 9 Sep 79 p 7

/Text/ In 1978 too industrial research activity has had to face a series of difficulties.

In addition to a situation characterized by our country's technological weakness with respect to competing economic systems, an unsatisfactory general economic situation for a large part of the year and a deterioration of the energy outlook, both national and international, have also made themselves felt.

Futhermore, industrial restructure and reorganization steps and measures to aid initiatives in the field of research have not yet resulted in a satisfactory solution.

In such circumstances, an evaluation is necessary of the positive attempt by the industrial apparatus in this field aiming at solutions of problems brought about by the competition in international markets, by the worsening of the energy situation, by the need of a north-south balance and by the improvement of environmental conditions in our country.

The EFIM Group /Manufacturing Industry Holding and Financial Company/, in spite of obstacles and setbacks of a general nature, has continued its activties in this field on a regular basis, allotting funds earmarked for research totaling 23.5 billion lire in 1978 and has substantially strengthened its programs in this sector.

For the five-year plan of 1979-1983 expenses for research will total about 270 billion lire, resulting in the creation of 450 positions. At the end of this five-year plan, total positions will reach 1,900.

Research carried on within the group takes place in concerns dealing with the introduction of innovative technologies of production processes, of realization of new products, and the improvement of already existing products. It also takes place in the two research centers of Istituto Ricerche Breda /Breda Research Institute/ and the Istituto Sperimentale Metalli Leggeri /Experimental Institute for Light Metals/, which deal mostly with long-term projects and core studies.

The fields of research in which the group's concerns are involved are very diversified.

In the helicopter and general aviation field, based on studies and research which led to the production of the Agusta A109 (the first helicopter planned and built entirely by Italian concerns),prototypes demonstrating greater flexibility of use and increased payload compared to the original model are being tested.

In the general aviation sector, SIAI-Marchetti continues its planning of feasibility studies for the new S211 aircraft, designed to answer basic flight training needs of the air forces of several countries.

The EFIM Group is also heavily involved in the field of energy conservation research.

Together with the research activities of SIV, which have involved a large variety of products ranging from plastic-glass windshields, auto glass in thin widths, multilayered safety glass, particular mention should be made of the effort involved in the design and realization of insulating, thermoreflecting glass, the use of which allows considerable energy savings.

OTB, which is also involved in research activities dealing with energy conservation is putting the finishing touches on a generator, the "Breda Sistema 91," based on a new concept, which allows very high thermal output.

The SOPAL concerns, involved in the sector of waterculture, can boast of a technological know-how which is definitively the vanguard of Europe and are able to face the best qualified Japanese or Israeli competition with the definitive startup of industrial canning of bass as well as the solution of some problems dealing with the change from introduction to raising cycles of the red porgy.

Further developments obtainable in this sector should be viewed not only for their specific production and work-related benefits, but also as the contribution waterculture may provide in satisfying Italian nutritional needs for animal protein, which today is mostly imported.

Despite the varied demands for research originating from various industrial sectors, the Istituto Ricerche Breda has, during the course of the year, regularly developed its own activities in the sectors of failure analysis and quality assurance and in the sector of research dealing mostly with metallurgy and ecology.

Following completion of the analysis phase at the Trino Vercellese center, the Istituto Ricerche Breda, thanks to the experience gained in this sector and coupled with the very high degree of specialization, was awarded the insurance inspection contract for the high pressure drum of the Garigliano Electronuclear Center.

In the field of research, making reference to the area of metallurgy, the Institute completed five research products in 1978 aided with financial contributions from CECA [European Coal and Steel Community] Assider.

Research done in the field of ecology, also aided financially by CNR [National Research Council], has dealt with compost for the transformation of solid refuse into fertilizer, conservation and reactivation of active mud for biological treatment of waters, as well as the study of methods and techniques for energy conservation of industrial plants.

The activity of the Istituto Sperimentale Metalli Leggeri deals with the improvement of processing and development technologies with regard to production and treatment of aluminum.

Among the contributions of the Istituto Sperimentale Metalli Leggeri dealing with the improvement of industrial production processes, the "sottobattente" casting project comes to mind, perfecting fusion technologies with which a plant has been set up able to produce aluminum circular forms and high-quality alloys.

In the sector of transportation industry materials, the Institute has completed the development of a whole series of alloys for naval and military use and has developed a new alloy for the manufacturing of auto bodies: ISMAL has begun the industrialization cycle of an alloy usable in the construction of car bumpers which enjoys widespread diffusion and has been used on some Italian models for U. S. Markets.

With regard to the materials used by the electromechanic industry, simulation tests have been run to monitor the operational behavior of alloy electrical conductors, followed by the experimentation with hyperconductive metals; such research tends to offer the electromechanic industry valid alternatives to expensive and rare materials on the technical as well as the commercial level.

Dealing with the solar energy project, in which the Institute and Alsco Malugani, the group concern which is interested in the production of solar panels, research activities have increased, with studies on the improvement in the structure of light alloy intake units, procedures for outer lining coupled with the definitive start-up of the system measuring output of plants for the production of thermal energy of solar origin.

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SWEDEN

GROWTH OF SWEDISH 1977-1980 R & D BUDGET EXAMINED

Paris LE PROGRES SCIENTIFIQUE in French Jan-Feb 79 pp 29-43

[Study conducted by the scientific service of the embassy of France in Stockholm. All additional information may be obtained from the Scientific Council of the French Embassy and Mr Denis Lellouche, secretary general of the Franco-Swedish Research Association: "Public Research and Development in Sweden"]

/Text/ The 1979-1980 Budget

Evolution Over the Last 3 Years

The draft budget for the 1 July 1979-30 June 1980 budget was submitted to the Swedish parliament by Mr Mundebo, minister of budget and economy in Mr Ullsten's minority government.

This budget, totaling some 171 billion 900 million Swedish krona (MKr, 1 Kr = 0.97 French francs) is characterized by a record deficit of 45,100 MKr, or about10 percent of the GNP.

Since the legislative elections will take place in the autumn of 1979 it is quite certain that the current government has submitted a budget aimed at accelerating the already beginning economic recovery.

Since research in Sweden is not coordinated the finance law submitted to parliament does not contain a recapitulation of finances. Therefore, the budget of its ministry must be studied if we wish to single out the amount allocated for research and development. An initial study was made of this budget bearing in mind information culled during the year in the course of visits to and discussions with various research and development officials in Sweden. It was subsequently refined through work meetings with Swedish officials from the Central Statistical Bureau (SCB). In any case, we should point out that this is an estimate, facilitated by the use of the recommendations contained in Frescati's manual, on the one hand, and the specifications provided by the SCB, on the other (see appendix).

Draft Research and Development Budget by Ministry

Tables 1-14 contain the detailed estimate by ministry of the research and development appropriations included in the budget for the next fiscal year. In order to follow the evolution of such appropriations, we have included in the tables the figures corresponding to the two preceding budgets, the 1977-1978 and 1978-1979 ones. The figures following the various agencies correspond to the items, subjects, and sectors used by the SCB in a variety of studies.

The results of the estimated research and development budget allowed for each ministry and its development over the past three years have been classified in Table 15.

It may be noted that the Ministry of Industry has allocated the highest amount, totaling some 18 to 20 percent of its budget, for research and development.

The three other ministries which have appropriated substantial funds for research and development are Defense (7 percent), Education (7.8 percent), and Agriculture (7.8 percent). The Ministry of Health and Social Affairs, whose budget accounts for about one-third of the overall budget, has allocated only a small part of its funds for research and development, totaling about one percent.

We must point out that the government's proposal calls for a total of 5,487 MKr[1] for research and development in 1979-1980, or an increase of 519 MKr compared with 1978-1979, or some 10.4 percent of the total. Let us bear in mind that the 1978 rate of inflation has been assessed at 7.5 percent.

This increase varies with each ministry. It is substantial for the Ministry of Education (14.31 percent), Health and Social Affairs (12.8 percent), Industry (13.33 percent), and Agriculture (7.79 percent). However, it is particularly low for the Ministry of Defense (2.3 percent), quite below the inflationary rate.

Table 16 shows a breakdown by ministry of the funds allocated in the 1979-1980 draft budget, along with figures for the two preceding budgets.

Five ministries account for about 90 percent of appropriated research and development funds, as follows:

Education..................	33.5	percent
Industry..................	21.3	"
Defense...................	18.3	"
Agriculture...............	8.5	"
Social Affairs............	7.8	"

1. Or about 5 billion 322 million francs.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200020002-5

Let us also note that the shares of the Ministry of Education and of the Ministry of Industry have risen, whereas that of the Ministry of Defense has been reduced, while the other two have remained virtually static.

Budget Analysis by Sector

The financing of research and development by major activity sector (see Table 17) may be described on the basis of Tables 1-14 and the evaluation of such financing by sector.

Technical and Industrial Research

The current development of the industrial sector is substantially different from the situation which prevailed in Sweden in the 1960's and beginning of 1970's. The volume of output was then rising by an annual average of 4.8 percent for the 1963-1974 period. On a parallel basis, the volume of exports increased by an annual average of 7.3 percent. Productivity in terms of the volume of output per labor hour was rising by 6.6 percent per year for the same period.

Between 1974 and 1977, conversely, an average annual decline of 2.6 percent was registered in the volumes of output and exports. On the other hand, there was a stagnation in productivity.

Compared with 1975 the share of industry in the country's overall output has declined. In 1977 and 1978 unemployment rose to a total of 117,000 unemployed, officially registered on 31 January 1979, to which we should add another 170,000 people receiving "aid" by the state within the framework of the antiunemployment struggle, or a total of about 7.1 percent of the active population. Table 18 sums up the current situation and the development of Sweden's industry.

In recent years a number of studies of the situation prevailing in Swedish industry and future development possibilities were carried out by various bodies such as the special delegation for economic policy, known as the Delegation of the Nine Wise Men, the Academy of Sciences for Engineering, IVA; Office for Technical Development, STU; National Industry Agency, SIND, the Boston Consulting Group, etc. As the result of these investigations a long-term industrial policy was formulated by the Swedish parliament in the spring of 1979.

Based on currently available figures, Table 17 shows the development of appropriations allocated for technical and industrial research. The state aid goes to finance works undertaken also by universities, polytechnical schools, and private or public research centers.

The Technical Development Agency (STU) is the central state authority for the support of technical research and development. The main lines governing this aid were established in the spring of 1978. They stipulate, among others, that the efforts of the STU in terms of sectorial and industrial policies, shall be coordinated within a technical development program. The technical priorities apply to procedures, production, acquisition of data for such procedures and electronic components, the socioeconomic area (labor environment, health, biotechnology), innovation, and energy. The efforts directed toward specific targets and targets with time limitations are carried out within the framework of the major areas of additional projects.

Furthermore, in the spring of 1979 the Swedish government will ask parliament to energize its aid to development funds, as follows:

- Regional development funds (utvecklingsfonden) existing on 1 July 1978 will be granted 202.5 MKr as advance subsidies;

- The national technical development fund (statens utvecklingsfonden, SUFO), abolished in November 1977, would be reestablished as the "Utvecklingsfonden for stora projekt," USP, or "Important Projects Fund;"

- A "Referential Facilities Fund," or FRA, will be established to facilitate the export of major Swedish projects abroad as examples of Swedish technology.

Energy

In 1978 energy consumption totaled 428 tw/h or zero growth compared with 1977. In particular, overall electric power consumption in industry declined 2.6 percent. Currently Sweden has six nuclear power plants in operation producing approximately 25 percent of the entire electric power output. Two other plants have been completed and are awaiting their nuclear fuel.

The energy sector is clearly the area in which the Swedish state has made the greatest research and development financial efforts since 1975, the year the first three-year plan was inaugurated. Let us recall that it was during this first plan that a mixed Franco-Swedish ATP was set up for the chemical storage of energy.

The energy commission was established during the first three-year plan. It was assigned the formulation of a number of proposals aimed at defining Sweden's energy policy through 1990. The commission submitted its report in March 1978.

The second three-year plan began on 1 July 1978 with a budget of 842 MKr. The priority targets of this program were stipulated. Specifically, it is a question of the following:

- Acquire the necessary knowledge for the solution of problems related to the development of the national and international situation in the field of energy;

- Increase the existing knowledge of relations between the energy system and the other areas;

- Provide knowledge making it possible to evaluate the introduction of new technologies or new power systems;

- Contribute to the development of technologies required for the reorganization of the energy system.

In order to meet the targets, the main lines of development applied to the following:

- Development of renewable sources of energy, whether solar, biological, or wind power;

- Energy savings.

Research and development allocations for energy pass mainly through the Ministry of Industry and the Ministry of Housing. They are distributed essentially by the Energy Research Office, DFE; the Technical Development Office, STU; the Construction Research Council, BFR; and the Committee for the Development of Energy Sources, NE.

The development of allocations for the last two budgets may be seen in Table 17, along with estimates for 1979-1980. A very substantial increase in such allocations may be noted. As things currently stand, the 1979-1980 allocations already made possible an increase of 22.6 percent compared with 1978-1979. The size of this governmental effort proves that the Swedish leaders have become aware of the entire gravity of the energy problem and the great advantage of promoting research and development in this area. Let us recall the substantial efforts planned in the field of energy savings. Parliament voted an energy economy plan for construction. The plan covers a ten-year span, through 1988, and would make it possible to save 35 tw/h per year. The total investment will be 31,000 MKr, 21,000 of which provided by the government. In order to participate to this effort the BFR will initiate research projects in this area.

Basic Research

With the exception of rural and veterinary sciences, basic research is done at the universities, polytechnical schools, and specialized research centers. Over 97 percent of the particularly substantial allocations, and nearly one-third of the state financing of research and development, go through the Ministry of Education. The balance comes essentially from the budget of the Ministry of Foreign Affairs. These are funds allocated for research in cooperation with developing countries.

Funds allocated by the STU to the polytechnical schools and universities, used essentially for the purchase of scientific or technical knowledge for specific practical purposes have not been recorded in the sector. The development of the effort made by Sweden in this basic sector is shown in Table 17. The figures show, specifically, the budgets of the various research councils. The planned budget growth in the sector is substantial: 13.6 percent, or higher that the currency depreciation rate.

Agriculture, Fishing, and Rural and Veterinary Sciences

The Agronomy and Agriculture University is under the jurisdiction of the Ministry of Agriculture. Even though some projects may be classified as basic research, an overall evaluation was made of the research and development package related to the agriculture, fishing, and rural and veterinary sciences sector. The major difficulty in this evaluation is the assessment of the research and development appropriation with the help of funds advanced by the Ministry of Foreign Affairs cooperating with developing countries, or in cases of bilateral cooperation.

Table 17 shows the development of funds for this sector. A reduction of funds appears to have taken place, as they accounted for 7.27 percent of the state's appropriations for research and development in 1977-1978, reduced to no more than 6.72 percent for 1979-1980. This fact is corroborated by the amount of budget increases, Δ = 4.54 percent which is lower than the inflationary rate.

Health, Working Conditions, and Social Welfare

The financing of research and development at the schools of medicine, pharmacy, and dentistry, and research subsidized by the Medical Research Council (MFR), all included in basic research, has not been included in the evaluation. Therefore, the share of this sector in research and development funds amounts to about 11 percent.

About two-thirds of research and development funds in this area come from the Ministry of Health and Social Affairs; 12 percent come from the Ministry of Labor, 8 percent from the Ministry of Foreign Affairs, and 8 percent from the Ministry of Industry, essentially through the STU.

Table 17 shows the development of this sectorial budget. Compared with 1978-1979 a substantial increase of about 14.5 percent has been allocated, showing the government's desire to make a substantial contribution to the social area.

Environment

Virtually all allocations come from the Ministry of Agriculture. Let us note, however, that not all of the financing managed by the National Environmental Protection Agency, SNV, has been recorded as research and development financing. This agency is in charge of purification stations, treatment of waste, natural reserves, etc. It is quite certain that some of the funds go to research. However, the percentage would be difficult to assess.

As Table 17 shows the amount of research and development in this sector has remained stationary, totaling 1.8 percent. the 1979-1980 draft budget stipulates an increase (8.74 percent) slightly higher than the rate of inflation (7.5 percent).

Space

Sweden has always engaged in research and development in the field of space research. It continues to actively participate in various international programs, particularly those developed within the framework of the European Space Agency. In October 1978 Sweden joined France in the study of SPOT (Earth Sounding Observation Satellite): it is participating in the development of a vehicle computer.

Furthermore, Sweden has a national space program using the Esrange base, near Kiruna, dealing essentially with sounding balloons and rockets.

Research and development financing in this sector comes from the Ministry of Industry and Ministry of Education, totaling about 1.6 - 1.9 percent of the overall appropriations. This represents a net increase of about 46.2 percent in the draft 1979-1980 budget. (see Table 17).

Conclusion

The amount of research and development financing submitted by the Swedish government to the parliament may be assessed at 5,487 MKr for the 1 July 1979-30 June 1980 budget. Compared with the previous budget year, this is an increase of 519 MKr, or 10.4 percent. Bearing in mind that inflation was 7.5 percent, this is a small yet real increase.

The research and development budget for 1979-1980 (5,487 MKkr) is about 3.2 percent of Sweden's budget. It corresponds to 1.26 percent of the Swedish gross national product and to 665 Kr per capita.[1] Table 19 shows the development of such financing over the past three budget years.

From the sectorial viewpoint we may note that the sectors to which the Swedish government pays greatest attention are basic research (31.5 percent); defense (20 percent); "health-labor conditions-social welfare" (11.3 percent); energy (10 percent); and technical and industrial research (about 9 percent). However, we should point out that adding to the "health-labor conditions-social welfare" sector the share of medical research (about 7.5 percent), included in basic research, a new breakdown would show up for 1979-1980, according to which three research and development sectors would appear to be of equal size, basic research accounting for about 24 percent, defense, 20 percent, and "medical sciences-health-labor conditions-social welfare," for 18.8 percent.

1. or 645 francs.

As to the draft 1979-1980 budget, the most substantial growth, space growth aside, is the following:

- Energy, +22.6 percent
- Health-improvement of labor conditions-social welfare, +14.5 percent;
- Basic research, +13.6 percent.

The suggested financing of these three sectors reveals perfectly the pragmatism displayed by the Swedish leaders: Having detected imperfections and weaknesses in their socioeconomic system, they are ready to make the necessary sacrifice to try to secure the relative technical and economic independence of their country in the future.

Appendix

List of Pertinent Sectors

1. Agriculture-Forestry-Fishing
2. Industrial Activities
3. Energy and Water Supplies
4. Transportation and Communications
5. Housing and Urban Affairs
6. Environment
7. Health
8. Social Welfare
9. Culture-Mass Media-Entertainment
10. Education-Pedagogy
11. Working Environment
12. Public Administration and Services
13. Earth and Atmospheric Sciences
14/ 14.1 Precision and Natural Sciences
    14.2 Technical Sciences
    14.3 Medical Sciences
    14.4 Rural and Veterinary Sciences
    14.5 Social Sciences
    14.6 Arts and Humanities
    14.7 Other Sciences (Research and Development)
15. Space Research
16. Defense

Table 1

Ministry of Foreign Affairs (in MKr)

Agencies	1977/1978 (1)	1978/1979 (2)	1978/1979 (3)
International Peace Research Institute..... (SIPRI) (12)	5.4	6.6	7.03
Hagfors Seismic Research Station........... (16)	2.05 (*)	2.35 (*)	2.6 (*)
SAREC International and Bilateral.......... Development (1, 7, 8, 12) (14.7)	112.7 (*)	125 (*)	138.4 (*)
Swedish Institute......................... (9) (10, 14.7)	1.35 (*)	1.45 (*)	1.45 (*)
Total	122.5	135.4	149.48

(*) Figure based on investigation

Table 2

Ministry of Defense (in MKr)

Agencies	1977/1978 (1)	1978/1979 (2)	1979/1980 (3)
Readjustment, Committees, and Central Services...... (16)	133.3 (*)	152.8 (*)	105.0 (*)
Army Research and Development.............. (16)	70	89	92
Navy......................................	30	43	47.5
Air Force.................................. (16)	473.3	392	418.2
Command.................................. (16)	3.0	3.2	2.4
Joint Research Service, FOA............... / Various Services, Academies, Materiel, etc. (16)	213.3 (*)	250 (*)	277 (*)
Civil Defense.............................	33.7 (*)	35.6 (*)	38.9 (*)
Capital Expenditures (Construction)........	16.5 (*)	17.9 (*)	25.5 (*)
Total.....................................	953.1	983.5	1,006.5

(*) Figure based on investigation

Table 3

Ministry of Health and Social Affairs (in MKr)

	1977/1978 (1)	1978/1979 (2)	1979/1980 (3)
Social Research: Research, Development,... and Testing (8)	18.5	21.4	23.5
Hospital Efficiency Institute (SPRI)....... (7)	8.5	9.4	11.1
Bacteriological Laboratory (SBL)........... (7,16)	13.2	17	19.2
Medicinal Drugs Control Laboratory......... (7)	22.2	26.2	28.9
Study of the Secondary Effects of Medicinal Drugs (within the framework of the OMS) (7)	--	0.9	1.0
Forensic Chemistry Laboratory.............. (12)	13.2	16.0	15.6
University Hospital Center:................ Karolinska, Uppsala, Dalby (7)	220.5 (*)	256.4 (*)	294.7 (*)
Adolescent Care Center..................... (8)	6.2 (*)	7.3 (*)	8.0 (*)
Alcoholism Research........................ (8)	7.4 (*)	8.6 (*)	9.5 (*)
Measures for the Handicapped............... (8)	10.1 (*)	10.6 (*)	11.1 (*)
Hospital Expansion (Karolinska and Uppsala) (7)	2.4 (*)	4.2 (*)	4.0 (*)
Total	322.2	378	426.6

Table 4

Ministry of Communications (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Swedish Meteorological and Hydrological Institute (SMHI) (13,6,12)	13.9 (*)	15 (*)	15.8 (*)
Roads and Traffic Institute (VTI) (4)	29.4	31.2	32.3
Geotechnical Institute (SGI) (3, 4, 5, 10)	1.5 (*)	1.70 (*)	1.90 (*)
Transportation Research Agency (TFD) (4)	11.2	9.5	9.9
Public Enterprises Funds (Postal Service, Telecommunications, Railroads) (12,4)	5.5 (*)	6 (*)	6.1 (*)
Total	61.5	63.4	66.0
Public Enterprises (12,4)	73.9 (*)	85.7 (*)	89.6 (*)
Total	135.40	149.10	155.60

Table 5

Ministry of Economy (in MKr)

Agency	1977/1978	1978/1979	1979/1980
Central Statistical Bureau (12)	16.4 (*)	18.1 (*)	18.0 (*)

Table 6

Ministry of Budget (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Central Administration..................... (12, 13, 16, 5)	28.9 (*)	33.2 (*)	32.7 (*)
Construction Projects...................... (11, 12, 13, 14,7, 16)	77 (*)	77 (*)	77 (*)
Computer Funds............................. (12)	16.5 (*)	11.5 (*)	16.5 (*)
Ministry Committees and Services.......(12)	0.4	0.5	0.6
Total	122.8	122.2	126.8

Table 7

Ministry of Education (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Joint Committees and Services.............. (10, 14,7)	2.0 (*)	2.1 (*)	2.1 (*)
1. Cultural Affiars Council............... (Museums, Archives, Antiques) (9)	12.4 (*)	14.4 (*)	22.3 (*)
2. Primary and Secondary Education:....... Pedagogical Development Work (10)	59.4 (*)	62 (*)	67.2 (*)
3. Higher Education and Research			
3.1. National Office of Universities and Higher Schools (UHA) (Investigations and Administration)................. (14.7)	14.3	14.3	15.4
3.2. Council for the equipment of Universities and Higher Schools...... (14,7)	5.3	5.9	6.7
3.3. Regional Office of Higher Schools.... (14.7)	2.3	2.6	2.9
3.4 Correlation between research and primary schooling.................... (14.7)	--	8	9.2

Table 7, (continued)

Agencies	1977/1978	1978/1979	1979/1980
3.5. School of Arts and Humanities........ (14.6)	52.8	79.9	87.9
3.6. School of Theology.................. (14.6)	4.0	6.0	6.5
3.7. School of Law....................... (14.5)	5.8	7.9	8.7
3.8. School of Social Sciences........... (14.5)	64.0	95.8	106.6
3.9. School of Medicine.................. (14.3)	180.8	232.9	253.6
3.10. School of Dentistry................ (14.3)	29.6	38.0	40.4
3.11. School of Pharmacy................. (14.3)	6.6	8.8	9.3
3.12. School of Sciences................. (14.1)	136.0	185.2	205.0
3.13. Technical Schools and Polytechnical Schools............... (14.2)	151.1	193.7	216.4
3.14. Cost of Premises of Higher Schools... (14.2) (14.7)	121.8 (*)	148.1 (*)	158.1 (*)
3.15. Postgraduate Studies................ (10, 14.1, 14.2, 14.5, 14.6)	43.8	53.0	56.4
3.16. Research and Development for......... Higher Schools (10)	20.6	17.6	17.6
3.17. Commission of Research Councils...... (14.7)	12.0	14.9	20.0
3.18. Council for Research in Humanities and Social Sciences (HSFR).......... (14.5) (14.6)	37.3	42.6	48.6
3.19. Medical Research Council (MFR)....... (14.3)	77.5	86.7	97.0
3.20. Council for Basic Sciences Research (NFR)..................... (14.1, 15)	136.0	155	223.6
3.21 CERN................................ (14.1)	37.1	38.7	--

Table 7, (continued)

Agencies	1977/1978	1978/1979	1979/1980
3.22. ESA/ESRO............................ (15)	19.9	20.1	24.5
3.23. Nuclear Research Institute (AFI).... (14.1)	7.1	7.8	10
3.24. Kiruna Geophysics Institute......... (13)	4.4	5.0	6.2
3.25. Sociological Research Institute..... (8)	1.9	2.3	2.5
3.26. International Economics Institute... (12)	1.3	1.7	2.0
3.27. Futurological Studies Institute..... (14.7)	3.4	3.7	4.0
3.28. International Meteorological Institute, Stockholm............... (12)	0.55	0.6	0.6
3.29. KVA, Royal Academy of Sciences...... (14.1)	7.8	4.7	6.3
3.30. Cancer research funds............... (14.3)	3.0	3.0	3.0
3.31. EISCAT.............................. (13)	1.0	1.0	1.0
3.32. Equipment and Appliances............ (14)	46.0	38	38.0
Total..................................	1,308.85	1,602	1,779.2

Table 8

Ministry of Agriculture (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Joint Committees and Services.............. (6)	5.4 (*)	6.0 (*)	8 (*)
1. Office of Fisheries.................... (1)	6.6 (*)	10.6 (*)	10.7 (*)

Table 8, (continued)

Agencies	1977/1978	1978/1979	1979/1980
2. Services and Controls (Food products, Veterinary, Agricultural Chemistry...) (1)	16.1 (*)	18.4 (*)	20.4 (*)
3. Teaching and Research			
3.1. Royal Agronomy College and Schools of Veterinary Medicine, Forestry, Agriculture, and Equipment.......... (14.4)	184.8 (*)	212.1 (*)	240.5 (*)
3.2. JFR, Agronomy Research Council...... (1)	40.7	44.8	46.3
3.3. KSLA, Agriculture and Forestry Academy............................ (1)	0.38	0.43	0.44
4. Environmental Protection (6)			
Environmental Protection Agency............	16.5	19.6	21.5
Radiation Protection Institute............. (6)	8.8	10.2	12.4
Environmental protection research.......... (6)	30.9	30.6	28.2
Radiation protection research.............. (6)	0.6	0.7	0.9
Collective environmental research.......... (6)	3.8	5.5	6.0
Studies of products dangerous to the health and the environment................ (7)	1.4	1.5	2.0
Special environmental studies.............. (6)	6.5	7.1	8.5
Program for the observation of the quality of the environment................ (6)	--	2.8	3.7
Contribution to the UNEP.................. (6)	4.6	8.0	9.0
Capital			
Construction work, school of agronomy...... (14.4)	38.6 (*)	55.9 (*)	49.5 (*)
Total....................................	365.68	434.23	468.04

Table 9

Ministry of Trade (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Consumption Research (12)	0.6 (*)	0.6 (*)	0.5 (*)
Economic Defense Office (16, 12)	2.6 (*)	3.4 (*)	4.1 (*)
Total	3.2	4.0	4.6

Table 10

Ministry of Labor (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Joint Committees and Services (11,12)	4.4 (*)	5.0 (*)	5.2 (*)
Workers Protection Office (11)	31.2 (*)	38.6 (*)	49.2 (*)
Labor Clinic (11)	0.5 (*)	0.6 (*)	0.3 (*)
Workers Protection Fund (11)	20	22	22
Total	56.1	66.2	77.6

Table 11

Ministry of Housing (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Public Buildings Office (11, 5)	1.0 (*)	1.2 (*)	1.6 (*)
Construction Research, including BFR (5.11)	85.0 (*)	95.5 (*)	103.0 (*)
Energy Saving Prototypes (3)	2.2 (*)	6.6 (*)	6.6 (1)
Registration (3, 12)	8.8 (*)	11.9 (*)	11.2 (*)
Total	97	115.2	122.4

(1) Temporary allocation

Table 12

Ministry of Industry (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Joint Committees and Services.............	3.5	4.0	5.1
1. National Industry Agency--Investigations (2)	1.2 (*)	2 (*)	2.2 (*)
2. Regional Development Fund.............	--	19.2 (*)	31.1 (*)
3. Norrland Fund.......................... (2)	10.0	10.0	10.0
4. Geological Prospecting, SGU............ (13)	8.4 (*)	8.9 (*)	9.8 (*)
5. Energy Saving in Enterprises (Prototypes).......................... (3)	42	56	59 (1)
6. Nuclear Safety Research................ (3)	--	21	23
7. Storage of Radioactive Materials....... (3)	10.1	12.0	21
8. Technical Research and Development.....			
8.1. STU................................ (2, 3, 4, 7, 8, 11) (14.2, 15)	291.0	364.5	403.7
8.2. European Space Cooperation (ESA)..... (15)	48.3	50.8	65.9
8.3. National Testing Laboratory (SP)..... (3, 11, 12)	23.1	24.4	31.5
8.4. Underwater Testing Laboratory........ (4, 12, 16)	4.3	5.0	6.4
8.5. Academies of Engineering Sciences (IVA).............................. (14.2)	0.97	1.08	1.00
8.6. Energy Research...................... (3)	120.4	238.5	283 (1)
8.7. Studsvik Energiteknik AB............. (3)	44.7	46.0	47.0
8.8. Energy Research and Development in Studsvik.......................... (3)	15.0	6.0	6.0
8.9. Data-Saab............................ (2)	--	104.9	70

Table 12, (continued)

Agencies	1977/1978	1978/1979	1979/1980
9. Nationalized Companies Fund (Vattenfall and Enterprise, FFV)................. (2, 3, 11, 16)	8.25 (*)	8.4 (*)	8.4 (*)
10. Ranstad (procedure development)....... (2)	24.0	49.0	41.0
Total	646.22	1,031.68	1,125.1
11. Nationalized Companies (Vattenfall and Enterprise, FFV).................	116.2 (*)	129 (*)	134.5 (*)
Total.....................................	762.42	1,160.68	1,259.6

(1) Temporary financing.

Table 13

Ministry of Justice (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Joint Committees and Services.............. (12)	4.6 (*)	4.7 (*)	5.4 (*)
Central Informatics Committee.............. (12)	0.9 (*)	1.1 (*)	1.3 (*)
Criminal Processing Office................. (12)	0.8 (*)	0.9 (*)	1.0 (*)
Total.....................................	6.3	6.7	7.7

Table 14

Ministry of Municipal Affairs (in MKr)

Agencies	1977/1978	1978/1979	1979/1980
Prefectures................................ (12)	5.5 (*)	6.5 (*)	6.8 (*)
Rescue Services............................ - Firemen - Struggle against hydrocarbon pollution	1.1 (*)	1.0 (*)	1.2 (*)
Total.....................................	6.6	7.5	8.0

Table 15. Estimated Research and Development Funding (Bt Ministry)

(1) Ministères	(2) Année 1977/1978			(3) Année 1978/1979			(4) Année 1979/1980			(14) R. et D. 1979 R. et D. 1978
	(5) Budget total MCRS	(6) Budget R. et D. MCRS	(7) Part R. et D. %	(8) Total MCRS	(9) R. et D. MCRS	(10) Part R. et D. %	(11) Total MCRS	(12) R. et D. MCRS	(13) Part R. et D. %	Δ (%)
Affaires étrangères (15)	3 970,7	122,5	3,08	4 391,1	135,4	3,08	4 973,6	149,48	3,01	10,4
Défense (16)	11 476,0	953,1	8,31	13 952,5	983,5	7,05	14 988,9	1 006,5	6,72	2,3
Affaires sociales (17)	34 792,5	322,2	0,93	41 623,1	378,0	0,91	46 504,2	426,6	0,92	12,8
Communications (18)	7 475,6	61,5	0,82	8 149,2	63,4	0,78	8 666,0	66,0	0,76	4,1
Economie (19)	331,6	16,4	4,95	399,3	18,1	4,53	349,5	18,0	5,15	—
Budget (20)	8 914,7	122,8	1,38	9 279,4	122,2	1,32	9 962,3	126,8	1,27	3,76
Education (21)	16 747,2	1 308,85	7,82	19 097,8	1 602,0	8,39	22 966,7	1 779,2 (*)	7,75	11,06 (*)
Agriculture (22)	5 339,7	365,68	6,85	5 657,3	434,23	7,68	5 982,0	468,04	7,82	7,79
Commerce (23)	463,4	3,2	0,69	1 136,8	4,0	0,35	1 289,2	4,6	0,36	15
Travail (24)	6 064,7	56,1	0,93	6 997,6	66,2	0,95	7 860,0	77,6 (*)	0,99	17,2 (*)
Logement (25)	7 553,8	97,0	1,28	10 478,5	115,2	1,20	12 730,6	122,4	0,96	6,25 (*)
Industrie (26)	4 558,2	646,22	14,18	5 144,3	1 031,68	20,05	6 061,7	1 125,1 (*)	18,56	9,06 (*)
Justice (27)	4 444,8	6,3	0,14	5 089,8	6,7	0,13	5 801,3	7,7	0,13	14,9
Communes (28)	1 671,4	6,6	0,39	2 032,6	7,5	0,37	2 144,1	8,0	0,37	6,67
Total (29)	113 804,3	4 088,45	3,59	133 429,3	4 968,11	3,72	150 280,1	5 386,0 (*)	3,58	8,41 (*)
Entreprises publiques (30)										
Ministère communications (31)	(13 690,0)	73,9		(15 872,0)	85,7		(16 600,0)	89,6		
Ministère industrie (32)	(6 882,0)	116,2		(7 638,0)	129,0		(7 967,0)	134,5		
Total général (33)		4 278,55 28,0 (1)			5 182,81 28,0 (1)			5 610,1 28,0 (1)		

(1) Fonds du tricentenaire de la Banque Nationale Suédoise. (34)
(*) Voir Tableau 15 (Annexe). (35)

(Key on following page)

Key:
(1) Ministry
(2) Year
(3) Year
(4) Year
(5) Total Budget MKr
(6) R & D Budget MKr
(7) R & D Share %
(8) Total NKr
(9) R & D MKr
(10) Share R & D %
(11) Total NKr
(12) R & D MKr
(13) Share R & D %
(14) R & D 1979 / R & D 1978 Δ %
(15) Foreign Affairs
(16) Defense
(17) Health and Social Affairs
(18) Communications
(19) Economy
(20) Budget
(21) Education
(22) Agriculture
(23) Commerce
(24) Labor
(25) Housing
(26) Industry
(27) Justice
(28) Municipal Affairs
(29) Total
(30) Public Enterprises
(31) Ministry of Communications
(32) Ministry of Industry
(33) Grand total
(34) (1) Funds of the National Bank of Sweden Tricentenial
(35) (*) See Table 15 (Appendix)

Table 15 (Appendix)

Estimates of Research and Development Funding (By Ministry)

Additional funding granted for research and development during the Swedish parliament debates of March 1979

Ministry	R & D Funding MKr	Δ (R & D 1979/1980 / R & D 1978/1979) %
Education......................	1,779.2 + 52	14.31
Labor..........................	77.6 + 5	24.7
Industry.......................	1,125.1 + 44.1	13.33

Total R & D funding for 1979/1980: 5,386.02 + 101.1 = 5,487.12 MKr or a 10.44 percent increase compared with 1978/1979.

Table 16

Components of Research and Development Funding (By Ministry)

Ministry	1977/1978 R & D Budget in MKr	1977/1978 %	1978/1979 R & D Budget in MKr	1978/1979 %	1979/1980 R & D Budget in MKr	1979/1980 %
Foreign Affairs..	122.50	3.00	135.40	2.72	149.48	2.72
Defense	953.10	23.31	983.50	19.80	1,006.50	18.343
Health and Social Affairs.......	322.20	7.88	378.00	7.61	426.60	7.784
Communications..	61.50	1.50	63.40	1.28	66.00	1.203
Economy.........	16.40	0.40	18.10	0.36	18.00	0.33
Budget..........	122.80	3.01	122.20	2.46	126.80	2.31
Education.......	1,308.85	32.01	1.602.00	32.25	1.831.20	33.37
Agriculture.....	365.68	8.95	434.23	8.74	468.04	8.53
Commerce........	3.20	0.08	4.00	0.08	4.60	0.08
Labor...........	56.10	1.37	66.00	1.33	82.60	1.51
Housing.........	97.00	2.37	115.20	2.32	122.40	2.23
Industry........	646.22	15.81	1.031.68	20.77	1,169.20	21.31
Justice.........	6.30	0.15	6.70	0.13	7.70	0.14
Municipal Affairs	6.60	0.16	7.50	0.15	8.01	0.15
Total...........	4,088.45	100.00	4,968.11	100.00	5,487.12	100.00

Table 17

Sectorial Breakdown of Research and Development Funding

	1977/1978		1978/1979		1979/1980		Δ 1979/1980 / 1978/1979 %
	Montant (1) MCRS	%	Montant (2) MCRS	%	Montant (3) MCRS	%	
(4) Recherche technique et industrielle	279,22	6,83	453,58	9,13	451,70 (*)	8,23	—
(5) Energie	287,2	7,02	444,5	8,95	545,00	9,93	22,61
(6) Recherche de base	1 233,55	30,17	1 523,75	30,67	1 730,75	31,54	13,58
(7) Agriculture, pêche, sciences rurales et vétérinaires	297,18	7,27	352,23	7,09	368,82	6,72	4,71
(8) Santé, conditions de travail, bien-être social	437,2	10,7	541,3	10,90	619,70	11,30	14,48
(9) Environnement	78,1	1,91	91,5	1,84	99.50	1,81	8,,74
(10) Espace	78,2	1,91	80,9	1,63	118,30	2,16	46,23
(11) Transports, communications	51,2	1,25	71,8	1,44	74,2	1,35	3,34
(12) Défense	1 023,5	25,02	1 055,55	21,24	1 082,50	19,73	2,56
(13) Divers	323,55	7,92	353,0	7,11	396,65	7,23	—

(*) Chiffre provisionnel. (14)

Key:

(1) Total MKr
(2) Total MKr
(3) Total MKr
(4) Technical and Industrial Research
(5) Energy
(6) Basic Research
(7) Agriculture, Fishing and Rural and Veterinary Sciences
(8) Health, Labor Conditions and Social Welfare
(9) Environment
(10) Space
(11) Transportation, Communication
(12) Defense
(13) Various
(14) (*) Temporary figure

Table 18

Evolution of the Situation in Swedish Industry

	1960	1965	1970	1975	1977	1978 (preliminary)
Number of employees .... (millions)	1,040	1,089	1,055	1,051	1,014	984
Percentage of total employment (%)	29.1	29.3	27.3	25.6	24.5	23.3
Share of Industry in the country's total output (%, current krona)........	31.6	30.7	30.0	31.9	27.6	26.4
Share of the machine sector in overall industrial output (current krona)....	36.6	36.9	37.3	42.6	43.6	42.6

Table 19

Evolution of State Financing of Research and Development and Intensity of Research and Development Effort

Year	State Budget in MKr	R & D in MKr	Share of R&D %	GNP in MKr	R&D/ GNP %	R&D/ Capita in MKr
1977/1978....	125,002.2	4.088.45	3.27	350.954	1.16	495.5
1978/1979....	151,592.7	4,968.11	3.28	390,764	1.27	602.1
1979/1980....	171,868.7 (*)	5,487.12	3.19	435,300 (*)	1.26	665.0

(*) Estimate.

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