A SUBJECTIVE VIEWPOINT—

The Use of Digital Computers in Western Germany

By H. K. Schuff*

History of Computer Installations in Western Germany

The first computers operating in post-war Germany had been constructed within Germany. These were developed at the Max Planck Institute in Göttingen, with two additional university machines under construction at Darmstadt and Munich [1]. These machines did not attain any importance, however, in the German economy.

In 1956, for the first time commercial computers were offered for sale or lease to the German industry. The relatively early appearance of computers in the German market was the result of severe competition offered by several United States firms eager to keep competitors from the German market, a factor that proved to have an important effect on the future of computers in Germany. The development started with punch card equipment installations, then existing in considerable numbers and at that time mostly equipped with IBM machines. Next, utilizing its strong position, IBM succeeded in installing the 650 computer in large numbers. Besides the IBM 650, only the French-built Bull Gamma 3 became important in the German industry.

The American computer manufacturers were primarily responsible for the early recognition that electronic computers could be applied to industrial operations. However, monthly rental costs for the machines ranged from 20,000 to 80,000 Deutschmarks. Because of the difficulties of reorganization and programming with integrated data processing, electronic machines could not be introduced at such prices into new fields, but only into the so-called classical punch card equipment working areas. In order to use a computer economically, a machine had to replace the working power of 20 to 80 office clerks; efficiency of the early computers was generally too low to achieve this. The same can be said of the older large-scale computers IBM 705 and Remington Rand UNIVAC I. Fortunately, only one of each type had been installed in Germany.

Sometime in 1958, the second phase of application of electronic computers in Germany began. It was characterized by appearance on the market of computers built by several German and European firms incorporating modern construction elements, such as ferrite core storage and transistors. The machines were only slightly more expensive than older United States computers, and, being of considerably higher efficiency, they permitted a much more economical application. In this phase the Siemens 2002 and the X-1 of the Dutch firm, Electrologica, really have succeeded in Germany. The UCT of Remington Rand was introduced from the United States in this phase; though still using a magnetic drum storage, it was considerably better than the older machines.

Development in the field of computers for scientific use somewhat deviated from the situation described above for industry. At universities and institutes the Z22 is dominant—a construction of Zuse working on the functional bits principle. In the beginning the machine was not very reliable; thus its broad flexibility could not be fully utilized. More recently, however, its reliability has been considerably improved. Today the Z22 is replaced by the Z23, a transistorized version of the Z22.

As a reaction to European computers of the second phase, IBM turned out the 7070 computer with considerably improved efficiency. This machine, however, was only a transition to the third phase in German development, starting in 1959 and marked by the appearance of the IBM 1401, ICT 1301 and Bull 300. Appearance on the market of these machines may be explained by the manufacturers' business policy rather than by a real industrial demand, since they are again of lower efficiency than former types. Thus it was not too surprising that IBM, having leased its 1401 in large numbers because of its prominent name, announced another development, the 1410, even before the first 1401 was actually installed. A similarly unusual situation arose with the 7070 and 7074 types.

From this behavior and from another firm's holding to the magnetic drum machine, an impression arises that these firms are even today hardput to offer machines which are really a match for European ones [2, 3, 4]. It is true that United States manufacturers have maintained their position in the field of electronic data processing with machines that are required mainly for reliable and safe performance, or, for those machines ordered when they were still on paper, where it was felt that a well-known manufacturer was important. The situation in the scientific computer field, however, is quite different. Here, the Zuse Z22/23, the LGP 30 and the IBM 1620 are prevalent. The Z22, which totaled about 40 in Germany, is now replaced by the Z23. These machines are dominating the university sector. The LGP 30, manufactured under license in Germany, is of some importance in the private sector—such as in engineering bureaus. The IBM 1620 is also restricted to the industrial sector, but it has had a considerable selling success for IBM, although it is less versatile and slower in performance than the Z23.

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During the past year, three new developments could be observed in the German computer market. First, large-scale computers are appearing, such as the IBM 7090, Remington Rand 1107 and 490 and Telefunken TR4, of which several are on order. Most of these machines will be installed at universities and at government institutions. One IBM 7090 is actually installed at an IBM computing center in Düsseldorf. Second, computers are being introduced for process control. There are seven firms competitive in this field in Germany: Thompson-Ramo-Wooldridge, General Electric (together with AEG), IBM (with its 1710), Eurocomp (with the Libratrol 500 of Librascope), Remington Rand (together with Westinghouse), Telefunken and Siemens. It is expected that these computers will be installed mainly in rolling mills and in the electric utilities industry. Third, several foreign computer manufacturers (American and others) are struggling to get into the German market. Because it is extremely difficult for firms not known to the German public to become established in the German computer market, several manufacturers are trying to sell their machines in cooperation with (licensed) European firms. This is the way RCA has succeeded in selling some 301's (ICT 1500 and Bull Gamma 30). Other large American firms, i.e., Burroughs and Philco, have not yet tried to enter the German market. The same can be said of most of the British firms, several of whom have withdrawn from selling computers in Germany after trying it in vain.

TABLE A. Computers Installed and Ordered in Western Germany (Spring, 1962)*

Firm	Type	Installations	Orders
Bull	Gamma ET	5	1
	Gamma 30	1	14
Electrologica	X-1	9	4
Ferranti	Pegasus	2	—
IBM	305	50	5
	650	70	—
	705	1	1
	1401	130	200
	1410	5	25
	7070/72/74	12	15
	7090	—	1
	1620	40	50
ICT	555	—	1
	1301	—	4
	1500	—	2
National Elliott	803	7	1
	390	2	1
	315	—	7
Olympia	Omega	1	1
Remington Rand	UCT I & II	33	13
	UIII	—	7
Eurocomp	LGP 30	15	—
Siemens	2002	17	21
Standard Elektrik Lorenz	ER 56	5	2
	Informatic	2	—
Standard Electric	Zebra	1	—
Telefunken	TR4	1	6
	TR5	1	3
Zuse	Z22	45	—
	Z23	17	10
	Z31	—	2
	Totals...	472	397

* See JD & A, Europe computer census. *Automatic Data Proc. Newsletter 6*, 24 (Apr. 30, 1962).

Computers in the Federal Republic of Germany

By early 1962, approximately 470 electronic computers and data processing systems had been installed and about 400 computers were on order in Western Germany. United States machines are again dominating the present-day phase of automation, even taking into account recent cancellations of several 1401 orders. The computers installed or on order as of early 1962 are shown in Table A. Grouping the machines according to industrial application is difficult, since the foremost manufacturers do not make the necessary information available; in fact, it seems to be considered an advantage to keep the market use obscure. In the university field, however, exact information is available and is given in Table B.

Application of Computers in Germany

Most of the computers already installed are applied to solving smaller scientific problems. The main application, however, is electronic data processing, especially using machines of types UCT, IBM 650, 1401, 1410 (presumed), 7070, NCR 315 (presumed), Bull Gamma 3 and Bull T30, ICT 1500 and 1301 and Z31 (presumed). The ER56, X-1 and Siemens 2002 are applied equally in commercial and scientific problems. The Z22 and 23, LGP30, NE803 and 402 and the IBM 1620 are used mainly for solving technical problems.

Commercial Applications. Commercial areas now processed by electronic machines are mostly identical with the so-called conventional punched card equipment working areas, i.e., all tasks concerning payroll, cost accounting, inventory, reorder handling in trade, bank (deposit and others) accounting, premium and policy registration in insurance, statistics and others. More recently, there have been successful efforts to integrate the works in question, to a certain degree, and to introduce mathematical methods—especially in statistics.

The idea of integrated data processing was introduced from the United States. It is an idea really worthy of appreciation as a final aim. Soon, however, it became obvious, especially in firms with old tradition (authorities, mining industry) that certain retarding elements were opposed to integrated data processing with the considerable reorganizations it involved. Therefore, in German firms, truly integrated data processing is but rarely found.

Instead, increased efforts have recently been made to automate other tasks solvable only by electronic computers, such as the problem of automatic production control, as initiated in several firms in the iron and steel industries as well as in the chemical industry, e.g., in BASF, August-Thyssen-Hütte, Dortmund-Hörder-Hütten-Union and Hoesch AG. Automatic work preparation exists, e.g., at Opel AG where a combination of an IBM 650 and a teletype network has been installed. Several commercial problems have been solved by applying special-purpose computers, such as order handling with the mail-order firm Quelle (Nuremberg) and seat reservation with the Deutsche Bundesbahn [5]. Moreover, analysis is done

TABLE B. Electronic Computers at German Universities
[As of February 1, 1962]

University Bonn, Institute for Applied Mathematics	ER 56, LGP 30 (7090 on order)
University Freiburg, Computation Center at Institute for Applied Mathematics	Z22, 2002
University Hamburg, Computation Center at Institute for Applied Mathematics	TR4, 650
University Heidelberg, Astronomy Computation Center	2002
University Kiel, Computation Center of the University	Z22, X-1
University of Köln, Institute for Applied Mathematics	ER56
University Mainz, Institute for Applied Mathematics	Z22, 2002
University Münster, Institute for Applied Physics	Z22
University Saarbrücken, Professorship for Applied Mathematics	Z22
University Tübingen, Computation Center in the Institute for Mathematics	2002
Technical University Berlin, Hahn-Meitner-Institute for Nuclear-Research, Mathematics Section	Z22, 2002
Technical University Aachen, Computation Center	Z22, 2002
Technical University Braunschweig, Computation Center and Institute for Computer-Science	Z22, X-1
Technical University Darmstadt, Institute for Applied Mathematics	650, ELAT DERA, NE803
Technical University Hannover, Institute for Mechanics	Z22
Computer Institute in the Institute for Applied Mathematics	(7072 with 1401 on order) 650
Technical University Karlsruhe, Computation Center	Z22, ER56
Technical University München	PERM, ZII
Geodetic Institute	Z23
Computation Center	(TR4 on order)
Technical University Stuttgart, Computation Center	Z22, ER56, PEGASUS
Max-Planck-Institute for Currents Research, Göttingen	G1
Max-Planck-Institute for Physics and Astro-Physics, München	G2, G3 (7090 on order)
Aerodynamic Research Establishment, Göttingen	650
Mining-Academy Clausthal-Zellerfeld, Institute for Mathematics and Mechanics	Z22
University Würzburg	Z22
Free University of Berlin	Z23
University of Frankfurt	Z23
University Giessen	Z23

in automating the post cheque service of the Deutsche Bundespost and in air traffic control.

Scientific Applications. Scientific calculations are mainly carried out by firms of the electric and machine construction industry. In this field, the works of AEG, Siemens, BBC and some computation centers are worthy of mention. Thermodynamics computations are carried out, i.e., the calculation of vapor tables, simulation of circuit processes in turbine plants, machinery, vibration analysis and others.

A wide area of electronic computer application is found in civil engineering. In this field extremely exact calculations with a minimum of simplifications are necessary, because this is the only way to obtain adequate material savings—particularly important in Germany. The leading position in this field is held by computation centers.

Operations Research. Recently, successful attempts have been made to apply mathematical methods in management economics. Several firms solve cost accounting by matrix calculus. Further, transport and inventory optimizing by aid of electronic computers is attempted.

Besides the works mentioned, in universities a large number of scientific tasks are carried out in several areas of technical and exact science, i.e., transformation of coordinates, heat propagation, high frequency studies, approximation of functions, electric filters, electromagnetic waves, spectroscopy, design of engineering structures, electronic networks, hydraulic works, Fourier series, algorithms in the theory of groups, combinatorial geometry, nuclear physics and others. Much work has been done by universities (in particular the Universities of Darmstadt, Mainz and Munich) in the field of the programming language, Algol 60. Application of computers in the military field is wholly unimportant at the present time.

Computation Centers. Aside from university computation centers and those belonging to and working for specific firms, there are three computation centers run by Remington Rand in Germany, two each by IBM and Zuse, and one each by ICT, National Elliot, Siemens, Standard Elektrik, Facit and Telefunken. These centers, it is true, are working on the development of scientific programs and on computation of orders. Their main aim, however, is publicity for their respective computers. In addition to these computation centers, an independent one exists in Germany for carrying out basic analysis for programming problems and for carrying out calculations for clients. This is the "Rechenzentrum Rhein-Ruhr" of the "Mathematischer Beratungs und Programmierungsdienst," an independent consulting firm concerned with all questions on application of electronic computers from the user's point of view. The computation center of this firm was established four years ago (equipment: X-1); during this time, it has dealt particularly with developing programs in statics, highway engineering, process control engineering, electronics and thermodynamics. Based and developed on this center's own work, there are programs for civil engineering and dynamics of tracery panels, in particular of continuous suspension girders, grid structures and building frameworks. These programs—identical with special solutions of Flexure differential equations—make heavy use of vector and matrix calculus as a mathematical tool, and proceed partly directly (with closed numerical solutions), partly by the iterative method. The programs also permit the calculation of forces, moments, torsions and dislocations in pipeline systems [7, 8]. Moreover, there exist smaller, specialized computing centers in conjunction with civil engineering bureaus. As a result there is severe competition in the field of electronic computation.

A particularly pressing problem in Germany at present is the shortage of computer programmers and operators. Academic commercially-engaged programmers are especially rare [9], and nothing is known of any training for programmers at universities. The scientific programmer situation is far better; nevertheless, the demand is also great in this field. A certain reservoir was the permanent emigration of Soviet-zone scientists. *Continued on page 628.*

March 31–April 4, 1963
National Association of Broadcasters, Chicago, Ill.

March 31–April 5, 1963
American Chemical Society—Spring Mtg., Los Angeles, Calif.

March, 1963
Gas Turbine Engineers Conference, Los Angeles, Calif.
American Rocket Society—Testing Conference, Orlando, Fla.
American Ortho-Psychiatric Association, Washington, D. C.
National Missiles and Space Conference, Washington, D. C.

April 1–5, 1963
American Management Association Seminar, New York, N. Y.
American College of Physicians, Denver, Col.

April 2–5, 1963
American Surgical Association, Phoenix, Ariz.

April 3–6, 1963
American Society of Public Administrators, Washington, D. C.
National Council of Teachers of Mathematics, Pittsburgh, Penn.

April 3–7, 1963
National Association of Women Deans and Counsellors, Boston, Mass.

April 8–11, 1963
American Personnel and Guidance Association, Boston, Mass.
Society of Automotive Engineers, Washington, D. C.

April 14–19, 1963
Electrochemical Society, Pittsburgh, Penn.

April 16–20, 1963
Council for Exceptional Children, Philadelphia, Penn.

April 16–21, 1963
American Physiological Society, Atlantic City N. J.
American Society of Biological Chemists, Atlantic City, N. J.

April 17–19, 1963
Institute of Environmental Sciences, Los Angeles, Calif.

April 17–20, 1963
Distributive Education Clubs of America, Chicago, Ill.
International Special Technical Conference on nonlinear Magnetics, Shoreham Hotel, Washington, D. C., sponsored by PGEC, PGIE, AIEE. Contact: J. J. Souzzi, BTL Labs., Whippany, N. J.

April 21–27, 1963
National Library Week, Nation-wide

April 22–24, 1963
American Oil Chemists Society, Atlanta, Ga.
Association of Iron & Steel Engineers, Baltimore, Md.

April 22–25, 1963
American Physical Society, Washington, D. C.

April 22–26, 1963
American Newspaper Publishers Association, New York, N. Y.

April 23–25, 1963
Petroleum Electric Supply Association, Houston, Tex.

April 28–May 2, 1963
National School Boards Association, Denver, Col.

April 29–May 2, 1963
Aerospace Medical Association, Los Angeles, Calif.

April, 1963
American Association of University Professors, San Francisco, Calif.
American Geophysical Union, Washington, D. C.

May 5–8, 1963
American Institute of Chemical Engineers, Buffalo, N. Y.

May 5–9, 1963
Society of American Bacteriologists, Cleveland, Ohio

May 6–8, 1963
National Aerospace Electronics Conference, Dayton, Ohio

May 6–10, 1963
American Institute of Architects, Miami Beach, Fla.
American Psychiatric Association, St. Louis, Mo.

May 7, 1963
Transportation Association of America, Washington, D. C.

May 9–11, 1963
American Institute of Industrial Engineers, Denver, Col.

May 14–16, 1963
National Aerospace Electronics Conference, Columbus, Ohio

May 16–19, 1963
American Association for Public Opinion Research, Long Beach, N. Y.

May 17–18, 1963
Symposium on Artificial Control of Biological Systems, at University of Buffalo, School of Medicine, Buffalo, N. Y., sponsored by PGBME, Buffalo Niagara Section.

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COMPUTERS IN WESTERN GERMANY—

Continued from page 617

Surveying the application of electronic computers in the German economy, a number of deficiencies can still be observed, arising partially from technical limitations of the computers offered, partially from rigidity of the organizations existing, and, last but not least, from the continuing lack of adequately trained personnel. In the last year, however, the situation has improved considerably, and it is no exaggeration to say that because of refinement of programming techniques the application of electronic computers in Germany is as advanced as anywhere in Europe.

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