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R. 239	R. 239	R. 267	R. 267
't that 'ere Arn't that	't that 'ere Arn't that	to talk very ingway, tak- usly, so that intoxicated, though but t some indi- t upon these toms—even t have previ- ome persons ly make up nder its in- ecisely as if	to talk very angway, tak- ously, so that y intoxicated, l though but et some indi- rt upon these toms—even t have previ- ome persons ly make up nder its in- recisely as if
onse; "the ship like a oice of my at it with he bags of	onse; "the ship like a oice of my at it with the bags of	atches were e. She was ck resounded s from shore	atches were e. She was ck resounded s from shore
y well stare s on either t it! How i; be pru- s accounts,	y well stare s on either t it! How h; be pru- s accounts,	which have upon other on board, in the English some disso- andish port,	which have upon other on board, in the English y some disso- landish port,
ie quarter- the other, nch of old it."	ie quarter- the other, nch of old it."	e, which in down three d souls that	e, which in down three d souls that
er. "How gun-room. y fathoms	er. "How gun-room. y fathoms	ention of ated a very n, lethargic n abdomen. were more ip's galley	ention of ated a very n, lethargic n abdomen, were more ip's galley.
auctioneer,	auctioneer,		
the hold. schooner? hts."	f the hold. schooner? ghts."		
d a mizzen-	d a mizzen-		
w—start it, it <i>must</i> be	w—start it, it <i>must</i> be		
ou ought to	ou ought to		

Figure 6. Two of the other instances of type damage which distinguish between the two 1850 impressions of the American edition of *White-Jacket* occur along the right margins of pages 239 and 267.

A Report Generator Approach to Automated Page Composition

J. R. Burns

Because of restrictions in the practical production of multiple copies of computer output by a line printer, a high-speed photocomposition system—the Master Typography System—was developed to work in conjunction with the Linotron 1010 at the US Government Printing Office. The system composes pages of repetitive, computer-based information using the report generator approach dedicated to a limited area of concern. The system is described and some typical output is illustrated.

The Federal Government is the largest user of computer equipment in the United States and frequently senses needs and deficiencies which hamper effective utilization of this equipment long before other users. As early as 1962 the Government had become aware of the inability of existing computer equipment to produce economically output when the number of copies exceeded some small amount.

The line printer is still the primary computer output device. Line-printer listings can be used in three different ways, the manner in which they are utilized being a function of the type and volume of distribution required.

When the number of copies is very small (less than 10), either a Multilith master or multi-part paper is used in the line printer; sometimes multiple passes through the computer are taken. The second method is to produce one copy of the listing and use photoreduction techniques for offset printing. The third method is to produce a source document; that is, to use the computer output to direct printing technicians who utilize classic graphic arts composition methods.

The line printer operates at a relatively high rate of speed. Its output, however, is crude from a graphic arts standpoint. A lot of space is wasted on the printed form; so much, in fact, that many publications consisting of totally computer-based data could not

economically use the photo-reduction technique and would have to be recomposed using classic methods.

In undertaking the study of possible alternate techniques, it was not just the problems of 1962 that concerned the Government but their correct anticipation that the amount of data within computer files would continue to increase at a phenomenal rate and that by the early 1970's many of the Government's computers would be devoted entirely to driving line printers if an alternative approach to the composition problem were not developed.

The primary observation of this study was that a high-speed, computer-compatible photocomposition device was needed which could replace the line printer's function when numerous copies were required. This device would be operated as a computer peripheral and dedicated entirely to the task of producing film for use in the production of offset printing plates.

The photocomposer would be capable of producing graphic arts quality output, and its ability to vary character width would enable it to place approximately 50% more characters on a photo-composed page than the line printer with fixed-width characters could. The economic ramifications of such a device were obvious. There would be 50% fewer pages to compose, 50% fewer plates, and 50% less paper. Distribution and storage costs would be reduced, and legibility would be greatly improved. Such a machine, however, would not be universally applicable to all the Government's printing needs. Only a subset of all graphic arts capabilities would be incorporated into the device, since it was intended to replace the line printer's function in composition of pages at a high rate of speed, not to produce display advertisements. The point-size range would be limited, the page size would be restricted, and the data would have to be computer-based.

As a result of the study, the Government undertook (in conjunction with private industry) the development of a system involving both hardware and software. Its hardware component is the Linotron 1010, the photocomposition device at the Government Printing Office. Its software component is called the Master Typography System and is involved with the extraction of data from its computer base.

This system concerns itself with very mundane applications, from a graphic arts standpoint. It composes numerous pages of repetitive,

computer-based information—such as technical abstract bulletins and parts lists. The typographic problems involved are less complex than those encountered in the composition of, for example, newspaper pages. The characteristics of the data which the system accepts are stringently and very explicitly defined. Data is already resident within a computer for some other purpose—inventory, accounting, etc.—and composed output is intended to be a by-product. Composition costs must be a primary concern. In newspaper production a page is reproduced hundreds of thousands of times; composition is a small portion of the overall cost. When the number of copies is small, composition becomes a large part of the production cost.

Using computers to compose complete pages is a relatively new application. Three basic approaches have been taken in the generation of software for this purpose.

The first method of automating the composition process can be compared to a computer's assembly language, since it requires instruction at a basic level. Several photocomposition systems of this sort have been developed. Their common characteristic is that they require the user to insert into his keyboarded or computer-based data, functions indicating the nature, extent, and duration of each element of the typographic process which the computer is expected to direct. Specially trained mark-up people and keyboarders are required. The result is up to a 30% increase in the number of keystrokes required to produce a manuscript. The system, however, maintains enough latitude to allow for composition of even the most sophisticated graphic arts applications.

The second method can be categorized as a language approach, similar to COBOL, the compiler-level language of the economic community. Different accounting problems are solved by writing different COBOL programs. The language approach to computerized photocomposition assume that the best method to automate page composition is to write a "program" in a typographic language for each particular job. Accountants, unfortunately, do not write COBOL programs in practice; nor are typographers going to be able to write typographic language programs.

The virtue, or vice, of both of these methods lies in their attempt to apply *all* the rules and techniques of graphic arts. Their output

can, in most cases, approximate what a typographer can manually accomplish.

The third method is the report generator approach to automated page composition, a compiler-level language dedicated to a *limited* area of concern. The commercial community's report generator is devoted to producing financial reports. Report generator requires that the user describe: (a) the file—the most general or largest common environmental characteristics data have; (b) the record—the specific characteristics of each of the individual components of the file, along with any indicators contained within the input; and (c) the process—a limited amount of processing information; what to do with input data when an indicator is or is not encountered within the record. The number of different ways data can be processed is limited.

The Master Typography System uses this technique. It requires that a given typographic application be analyzed and that someone—preferably someone familiar with typography—describe the system's equivalent of the file; that is, its page environment. He must describe the equivalent of the records, or components of the file; in this case, the paragraphs, lines, or line segments comprising the page. The processing information is not included in the job description, however. The process-flow directions required by the system are embedded in it. Only a discreet number of typographic events are allowable.

Switches within the system are set on or off depending upon conditions encountered during the generation of a page, but the Typography System only allows data to pass through the logical components according to a limited number of pre-defined routes. The system does not pretend to have taken into account all possible combinations of typographic occurrences, but it does encompass many sophisticated components of the page and line logic required in the generation of the specific kinds of jobs it was developed to handle.

Figure 1 is a representative page from the Army, Navy, Air Force, and Marine cross-reference listing which relates Federal stock numbers to industry part numbers. It is published yearly with quarterly supplements; 50,000 original pages are composed per year. On an IBM 360 Model 50 composition takes 20 seconds per page; phototypesetting time on the Linotron 1010 is 14 seconds per page. Notice that the page has four columns; the job has no hyphenation

but does have first line/last line entries which the system's software must produce.

Figure 2 is a page from the *National Zip Code Directory*. This six-column job runs approximately 1600 original pages per year with quarterly supplements averaging 125 pages. Computer time runs 20 seconds per page; composition on the 1010 takes 15 seconds per page.

Figure 3 is a page from the Navy's *Thesaurus of Engineering Terms* which runs about 660 pages. While it appears simple in format, it is fairly complex from a software standpoint. Notice the continued heading "Air Pollution"—the fluid nature of our system's page formatting necessitates a substantial set of logic equations to implement automation of the insertion of such headings. The first entry in column two, for example, might initially be placed at the bottom of column one. It is not good typography to end a column with a bold subhead, so the system moved this entry together with the following italic line to column two. A decision by the system to perform such a move is made after the fact, so to speak. If such a decision were made at the end of the last column, the last-entry logic is effected. For example, "Aldosterone", if moved to the next page, is no longer this page's last entry nor the next page's continued heading. Our system accommodates up to seven levels or hierarchies of headings which further complicate heading logic.

Figure 4 is a page from the *United States Government Research and Development Report*, a bi-monthly publication running about 200 pages per issue. The computer takes about 17 seconds per page; the composer requires approximately 20 seconds per page.

Figures 5 and 6 show a page from the *National Directory of Post Offices* and the Master Typography System forms which were used to direct our report generator. An analyst was required to insert into the file specification form of the report generator (the form equivalent to our page descriptor form) information indicating that a representative page in this particular application was five columns, that the column separation factor or width was 100 points, and that the column length was 707 points. He also indicated that if a page were to be set short due to insufficient data, the data was to be distributed among all five columns, and justified only when the resultant column depth was greater than the justification tolerance, 200 points. The remainder of the page descriptor portion of this form is devoted to the

NUMERICAL LIST OF POST OFFICES BY ZIP CODE AND SECTIONAL CENTERS

Post Office	Post Office	Post Office	Post Office	Post Office	Post Office	Post Office	Post Office	Post Office	Post Office
00601 San Juan, PR	00602 San Juan, PR	00603 San Juan, PR	00604 San Juan, PR	00605 San Juan, PR	00606 San Juan, PR	00607 San Juan, PR	00608 San Juan, PR	00609 San Juan, PR	00610 San Juan, PR
00611 San Juan, PR	00612 San Juan, PR	00613 San Juan, PR	00614 San Juan, PR	00615 San Juan, PR	00616 San Juan, PR	00617 San Juan, PR	00618 San Juan, PR	00619 San Juan, PR	00620 San Juan, PR
00621 San Juan, PR	00622 San Juan, PR	00623 San Juan, PR	00624 San Juan, PR	00625 San Juan, PR	00626 San Juan, PR	00627 San Juan, PR	00628 San Juan, PR	00629 San Juan, PR	00630 San Juan, PR
00631 San Juan, PR	00632 San Juan, PR	00633 San Juan, PR	00634 San Juan, PR	00635 San Juan, PR	00636 San Juan, PR	00637 San Juan, PR	00638 San Juan, PR	00639 San Juan, PR	00640 San Juan, PR
00641 San Juan, PR	00642 San Juan, PR	00643 San Juan, PR	00644 San Juan, PR	00645 San Juan, PR	00646 San Juan, PR	00647 San Juan, PR	00648 San Juan, PR	00649 San Juan, PR	00650 San Juan, PR
00651 San Juan, PR	00652 San Juan, PR	00653 San Juan, PR	00654 San Juan, PR	00655 San Juan, PR	00656 San Juan, PR	00657 San Juan, PR	00658 San Juan, PR	00659 San Juan, PR	00660 San Juan, PR
00661 San Juan, PR	00662 San Juan, PR	00663 San Juan, PR	00664 San Juan, PR	00665 San Juan, PR	00666 San Juan, PR	00667 San Juan, PR	00668 San Juan, PR	00669 San Juan, PR	00670 San Juan, PR
00671 San Juan, PR	00672 San Juan, PR	00673 San Juan, PR	00674 San Juan, PR	00675 San Juan, PR	00676 San Juan, PR	00677 San Juan, PR	00678 San Juan, PR	00679 San Juan, PR	00680 San Juan, PR
00681 San Juan, PR	00682 San Juan, PR	00683 San Juan, PR	00684 San Juan, PR	00685 San Juan, PR	00686 San Juan, PR	00687 San Juan, PR	00688 San Juan, PR	00689 San Juan, PR	00690 San Juan, PR
00691 San Juan, PR	00692 San Juan, PR	00693 San Juan, PR	00694 San Juan, PR	00695 San Juan, PR	00696 San Juan, PR	00697 San Juan, PR	00698 San Juan, PR	00699 San Juan, PR	00700 San Juan, PR

Figure 1. A representative page from the U.S. Army, Navy, Air Force, and Marine Master Cross Reference List. (All sample pages illustrated are produced from actual Linotron 1010 output.)

Figure 2. A page from the National Zip Code Directory.

772420
0064

29730
0001

RESEARCH AND DEVELOPMENT REPORTS

AD-665-297	AD-665-298	AD-665-299	AD-665-300	AD-665-301	AD-665-302	AD-665-303	AD-665-304	AD-665-305	AD-665-306
AD-665-307	AD-665-308	AD-665-309	AD-665-310	AD-665-311	AD-665-312	AD-665-313	AD-665-314	AD-665-315	AD-665-316
AD-665-317	AD-665-318	AD-665-319	AD-665-320	AD-665-321	AD-665-322	AD-665-323	AD-665-324	AD-665-325	AD-665-326
AD-665-327	AD-665-328	AD-665-329	AD-665-330	AD-665-331	AD-665-332	AD-665-333	AD-665-334	AD-665-335	AD-665-336
AD-665-337	AD-665-338	AD-665-339	AD-665-340	AD-665-341	AD-665-342	AD-665-343	AD-665-344	AD-665-345	AD-665-346
AD-665-347	AD-665-348	AD-665-349	AD-665-350	AD-665-351	AD-665-352	AD-665-353	AD-665-354	AD-665-355	AD-665-356
AD-665-357	AD-665-358	AD-665-359	AD-665-360	AD-665-361	AD-665-362	AD-665-363	AD-665-364	AD-665-365	AD-665-366
AD-665-367	AD-665-368	AD-665-369	AD-665-370	AD-665-371	AD-665-372	AD-665-373	AD-665-374	AD-665-375	AD-665-376
AD-665-377	AD-665-378	AD-665-379	AD-665-380	AD-665-381	AD-665-382	AD-665-383	AD-665-384	AD-665-385	AD-665-386
AD-665-387	AD-665-388	AD-665-389	AD-665-390	AD-665-391	AD-665-392	AD-665-393	AD-665-394	AD-665-395	AD-665-396
AD-665-397	AD-665-398	AD-665-399	AD-665-400	AD-665-401	AD-665-402	AD-665-403	AD-665-404	AD-665-405	AD-665-406

003037
0001

Figure 3. A page from the U.S. Navy Thesaurus of Engineering Terms.

Figure 4. A page from the United States Government Research and Development Report.

002027
0013

002027
0013

002027
0013

typesetting of the job and frame numbers in the lower left-hand corner of the page.

In the equivalent of the record specification forms of report generator (the forms which we have are called item descriptor forms) the analyst specified that the items were to be set 6-point on 7-point; that between items dot leaders were to be used, and that the textual components of each item was to be flushed or quadded left against the column origin while the numeric portion flushed left against an indent of 72 points from the column origin. He also specified that if an entry which was to be quadded left in the textual portion exceeded the measure allowable, 72 points, it should overflow on to the next line with a secondary indent of 8 points. He indicated that the dot leaders were to be used from the bottom component of the possible multiple-line entry. In addition, the Y-origin of each individual data item was to be 70 points if it starts a new column or page.

Figure 5. A page from the *National Directory of Post Offices*.

State List of Post Offices		
Seminole Beach, Br. Eau	32935	South Pasadena, Br. Saint
Calie	32935	Petersburg
Satsuma	32989	South Trail, Br. Sarasota
Sudley Field, Br. Pensacola	32510	South Venice, Br. Venice
Scottsmeer	32735	Southwest, Br. West Palm Beach
Seabreeze, Sta. Daytona Beach	32020	Southwest, Br. Winter Haven
Seaside, Sta. Lakeland	32601	Southwest, Br. Sarasota
Sebastian	32958	Southport, R. Br. Panama City
Selby (1st)	32870	Southport, R. Br. Panama City
Selby (2nd)	32870	Southport, R. Br. Panama City
Selby (3rd)	32870	Southport, R. Br. Panama City
Selby (4th)	32870	Southport, R. Br. Panama City
Selby (5th)	32870	Southport, R. Br. Panama City
Selby (6th)	32870	Southport, R. Br. Panama City
Selby (7th)	32870	Southport, R. Br. Panama City
Selby (8th)	32870	Southport, R. Br. Panama City
Selby (9th)	32870	Southport, R. Br. Panama City
Selby (10th)	32870	Southport, R. Br. Panama City
Selby (11th)	32870	Southport, R. Br. Panama City
Selby (12th)	32870	Southport, R. Br. Panama City
Selby (13th)	32870	Southport, R. Br. Panama City
Selby (14th)	32870	Southport, R. Br. Panama City
Selby (15th)	32870	Southport, R. Br. Panama City
Selby (16th)	32870	Southport, R. Br. Panama City
Selby (17th)	32870	Southport, R. Br. Panama City
Selby (18th)	32870	Southport, R. Br. Panama City
Selby (19th)	32870	Southport, R. Br. Panama City
Selby (20th)	32870	Southport, R. Br. Panama City
Selby (21st)	32870	Southport, R. Br. Panama City
Selby (22nd)	32870	Southport, R. Br. Panama City
Selby (23rd)	32870	Southport, R. Br. Panama City
Selby (24th)	32870	Southport, R. Br. Panama City
Selby (25th)	32870	Southport, R. Br. Panama City
Selby (26th)	32870	Southport, R. Br. Panama City
Selby (27th)	32870	Southport, R. Br. Panama City
Selby (28th)	32870	Southport, R. Br. Panama City
Selby (29th)	32870	Southport, R. Br. Panama City
Selby (30th)	32870	Southport, R. Br. Panama City
Selby (31st)	32870	Southport, R. Br. Panama City
Selby (32nd)	32870	Southport, R. Br. Panama City
Selby (33rd)	32870	Southport, R. Br. Panama City
Selby (34th)	32870	Southport, R. Br. Panama City
Selby (35th)	32870	Southport, R. Br. Panama City
Selby (36th)	32870	Southport, R. Br. Panama City
Selby (37th)	32870	Southport, R. Br. Panama City
Selby (38th)	32870	Southport, R. Br. Panama City
Selby (39th)	32870	Southport, R. Br. Panama City
Selby (40th)	32870	Southport, R. Br. Panama City
Selby (41st)	32870	Southport, R. Br. Panama City
Selby (42nd)	32870	Southport, R. Br. Panama City
Selby (43rd)	32870	Southport, R. Br. Panama City
Selby (44th)	32870	Southport, R. Br. Panama City
Selby (45th)	32870	Southport, R. Br. Panama City
Selby (46th)	32870	Southport, R. Br. Panama City
Selby (47th)	32870	Southport, R. Br. Panama City
Selby (48th)	32870	Southport, R. Br. Panama City
Selby (49th)	32870	Southport, R. Br. Panama City
Selby (50th)	32870	Southport, R. Br. Panama City
Selby (51st)	32870	Southport, R. Br. Panama City
Selby (52nd)	32870	Southport, R. Br. Panama City
Selby (53rd)	32870	Southport, R. Br. Panama City
Selby (54th)	32870	Southport, R. Br. Panama City
Selby (55th)	32870	Southport, R. Br. Panama City
Selby (56th)	32870	Southport, R. Br. Panama City
Selby (57th)	32870	Southport, R. Br. Panama City
Selby (58th)	32870	Southport, R. Br. Panama City
Selby (59th)	32870	Southport, R. Br. Panama City
Selby (60th)	32870	Southport, R. Br. Panama City
Selby (61st)	32870	Southport, R. Br. Panama City
Selby (62nd)	32870	Southport, R. Br. Panama City
Selby (63rd)	32870	Southport, R. Br. Panama City
Selby (64th)	32870	Southport, R. Br. Panama City
Selby (65th)	32870	Southport, R. Br. Panama City
Selby (66th)	32870	Southport, R. Br. Panama City
Selby (67th)	32870	Southport, R. Br. Panama City
Selby (68th)	32870	Southport, R. Br. Panama City
Selby (69th)	32870	Southport, R. Br. Panama City
Selby (70th)	32870	Southport, R. Br. Panama City
Selby (71st)	32870	Southport, R. Br. Panama City
Selby (72nd)	32870	Southport, R. Br. Panama City
Selby (73rd)	32870	Southport, R. Br. Panama City
Selby (74th)	32870	Southport, R. Br. Panama City
Selby (75th)	32870	Southport, R. Br. Panama City
Selby (76th)	32870	Southport, R. Br. Panama City
Selby (77th)	32870	Southport, R. Br. Panama City
Selby (78th)	32870	Southport, R. Br. Panama City
Selby (79th)	32870	Southport, R. Br. Panama City
Selby (80th)	32870	Southport, R. Br. Panama City
Selby (81st)	32870	Southport, R. Br. Panama City
Selby (82nd)	32870	Southport, R. Br. Panama City
Selby (83rd)	32870	Southport, R. Br. Panama City
Selby (84th)	32870	Southport, R. Br. Panama City
Selby (85th)	32870	Southport, R. Br. Panama City
Selby (86th)	32870	Southport, R. Br. Panama City
Selby (87th)	32870	Southport, R. Br. Panama City
Selby (88th)	32870	Southport, R. Br. Panama City
Selby (89th)	32870	Southport, R. Br. Panama City
Selby (90th)	32870	Southport, R. Br. Panama City
Selby (91st)	32870	Southport, R. Br. Panama City
Selby (92nd)	32870	Southport, R. Br. Panama City
Selby (93rd)	32870	Southport, R. Br. Panama City
Selby (94th)	32870	Southport, R. Br. Panama City
Selby (95th)	32870	Southport, R. Br. Panama City
Selby (96th)	32870	Southport, R. Br. Panama City
Selby (97th)	32870	Southport, R. Br. Panama City
Selby (98th)	32870	Southport, R. Br. Panama City
Selby (99th)	32870	Southport, R. Br. Panama City
Selby (100th)	32870	Southport, R. Br. Panama City

Figure 6. The Master Typography System forms used to direct the report generator.

PAGE DESCRIPTOR FORM

GRID SELECT CARD

1st GRID NO.	2nd GRID NO.	3rd GRID NO.	4th GRID NO.	DELETE	FORMAT NO.	IDENT
1728					728	

FUNCTION CODE ASSIGNMENT CARD

FRONT	REAR	SHFT	UNSHFT	WORD	LOCATION	UNDER-	END OF	TYPE	GRID	BAR	VERTICAL	LEADER	END OF	REV	FOOT-	GRAPHIC	PAUSE	FORMAT	POINT	INPUT	INPUT	END OF	END OF	INPUT	FORMAT	CARD	CARD
R		\$	*		L																						

PAGE DESCRIPTOR CARD NUMBER 1

NO OF	NO OF	COLUMN	COLUMN	COLUMN	LAST	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	29th	30th		
5	2	100	707	200																																	

PAGE DESCRIPTOR CARD NUMBER 2

PAGE	SPECIAL	ASPECT	GRID	TYPE	PAGE	SPECIAL	ASPECT	FOLD	CONTINUED	FILM	PAGE	LINE	FOLD	INPUT	1st	LAST	ALIGNED	FORMAT	CARD	CARD
S	G	F	I	I	S	G	F			M				L						

FRAME & JOB NUMBER PARAB

FORMAT PARAB

(INPUT CODE STRUCTURE)

CONTINUED CONSTANT

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

ITEM DESCRIPTOR FORM - 1

LOCATOR/FIELD CARD NUMBER 1

POINT	LEADING	LINE	LOCATOR	LOCATOR	Y	G - I	SEAL OR	SECONDARY	MARGIN	MIN	MAX	LENGTH	LEADING	FIELD	END OF	END OF	BETWEEN	FORMAT	CARD	LOCATOR
6	7	72	7	70	8	4	8											728		01
6	7	86																728		02
6	7	72	7	70	8	4	8											728		03
6	7	86																728		04
7		525																728		47
7		525																728		48

ITEM DESCRIPTOR FORM - 2

LOCATOR/FIELD CARD NUMBER 2

FORMAT	LEADER	GRID	TYPE	LINE	TYPE	LOCATOR	LEADER	LEADER	DOUBLE	HEAD	HEAD	SET	SPLIT	FOOT	START	SUP-	UNDE-	RULE	START	LOC	CONT.	FORMAT	CARD	LOCATOR
C	B	I	I	L	Y	S	U	I	N				Y											01
C	B	I	I	L	Y	S	U	I	N				Y											02
C	B	I	I	L	Y	S	U	I	N				Y											03
C	B	I	I	L	Y	S	U	I	N				Y											04
T	I	I	I	L	Y	U			N				N											47
T	I	I	I	R	Y	U			N				N											48

Information of this sort is all pertinent to the individual components of the page and is included in the item descriptor forms. Both the page and item characteristics were specified by the analyst external to the input data, that is, independent of the input data. The Master Typography System allows up to fifty item descriptors to occur on every page. Descriptors 47 and 48, as shown here, are normally used for right and left folios. Each of these examples required far less than fifty descriptors; the last example required only four. The user obviously has quite a bit of latitude in the generation and design of the page and individual items.

The unique characteristic of the overall system, due to the Linotron 1010 hardware, is its bias toward a page environment. The basic unit of composition is a page, not so much from the standpoint of the software, but because the unit of composition information within the photocomposer is a page. The Linotron 1010 is basically a closed-circuit television system capable of producing an $8 \times 10\frac{1}{2}$ -inch page with no motion of the film. It probably is one of the world's most resolute xy plotters, and zero access time is required to get to any point on the cathode display. Consequently, the software has a great deal of latitude in selecting the order in which it places characters on the page. A measure of the flexibility of the system lies in the fact that to date the Government Printing Office has photocomposed 350 different formats, totalling several hundred thousand pages. A format is defined as an entire job layout; it may have short pages and radical variations of individual page design—but it is a format. No modifications of the software has been needed. The system's aim is full-page composition with no manual intervention.

To date most other computerized composition systems have completely ignored the page-logic portion of the overall problem. There is little argument, however, that it is in full-page composition that the real economies of the photocomposition process can be realized.

This paper was presented at the conference, Where is Technology Leading Communications? held in February in Washington, D. C., and sponsored by the Engineering Writing and Speech Group of the Institute of Electrical and Electronics Engineers. Proceedings of the entire conference will be published by the Institute.

Letterforms in the Arts

This department is an international gallery for the display of artists' work (in various media) which involves the use of letterforms and related symbols. Artists, art and design schools, and other interested persons are invited to submit appropriate works and comment; communications should be addressed to the editor.

Jack Smith (1 Ashbridge Road, Leytonstone, London E11; dealer: Marlborough Fine Art, London) has had numerous one-man exhibitions and his work has been shown in such international exhibitions as the Pittsburgh International and the Venice Biennale. "He uses his picture surfaces as color fields on which to inscribe signs that range all the way from recognizable, semi-descriptive hieroglyphs whose meaning in the particular context is left open, to an invented form of writing, placed like writing on a page. Sound and silence are as much part of his purpose as visual language; interval, intensity, and density function importantly in the result" (*Art International*, March 1968). Accompanying comments are by Mr. Smith.

Various Activities No. 5, 1966.

An attempt has been made to break away from centers of interest. The painting is to be read from side to side. The marks are a kind of color shorthand, a visual equivalent of sound and speech, speed and interval; in this way they have something in common with a musical score. (A musician once remarked that he thought he could conduct the whole exhibition.) Occasionally the sound or the associations connected with a word influence the color. States of mind, changing from day to day, influence the individual forms within the painting; each form is influenced by the preceding mark; sometimes a mark is a sound. It is a mistake to try and read any passage as they only work visually; the vocabulary is one of line, mass, color, activities, and stillness; there is no word content. They can be thought of as visual poetry, but they are not to be confused with concrete poetry. It is essential that my paintings are only visually understood. They are sound scores concerned with harmonies, discords, and pauses. Certain open forms are dotted rather than firmly contained within a line; these exist as half thoughts. Each painting contains passages which are tranquil or disturbed—they occasionally produce states of unease in the spectator, possibly because they contain conflicting emotions. The harmony of the painting is established intuitively. The forms are not always ideograms or