PAGE

SIMULATOR DISCREPANCY REPORT

RPT. NO. LM-LUM-81

FACILITY FMES/FCI

DATE

ORIGINATOR(S) S. Greene

NASA COORD. H. Shelton

PNGCS/AGS PROGRAM IDENTIFICATION LUM 131 Rev. 8

TEST IDENTIFICATION H2OT-7.2 #1, 1/27/70

FUNCTION IN QUESTION Hardware restart effects on LUM 131 Rev. 9.

SYMPTOMS - The above run was to test the effects of hardware restarts on the closed-loop primary system. Observed effects were:

1. The frequency of navigation updates in P20 is drastically reduced.
2. The input data and the resultant computations in P32 up to a trial solution were changed by a restart.
3. In the rate command mode with pitch ACA out of detent, a restart causes a temporary control reversal which is soon corrected.

Other symptoms, such as an indicated checklist on radar switch position, other navigation effects; unstable displays are not yet confirmed to be due to restarts. But investigation is continuing in all of these areas

RECOMMENDED ACTION

Check with MIT

DISPOSITION

Date ____________ NASA APPROVAL ____________

STIMULATOR DISCREPANCY REPORT

RPT. NO. LM-LUM-89

FACILITY FMES/FCI

DATE 13 February 1970

ORIGINATOR(S) C. Tillman CFT

NASA COORD. H. Shelton

LOCATION IDENTIFICATION PAC - Program: Rev. 3 LUM131A (Rev 1 LM 131), LUMINARY 1C.

TEST IDENTIFICATION H20T-6.12#3 (PDI Auto, 9.5% TLOSS)

FUNCTION IN QUESTION PAC load of FRANK 32 shifted up one address. Program hung up at entry to I63.

SYMPTOMS. This SDR resulted from the investigation of a PDI run which was stopped because the program hung up at the entry into I63, apparently at the ignition algorithm. The start of the run and operation up to this point had been normal. Check of N38 (time of State Vector Integration) showed an integration going backwards in time. The E Memory was dumped and the state vector times and TLAND were checked and found to be right. I then had the Fixed Memory constant GUIDDURN checked and it was found to be a very large positive number (30373, 00004). This constant is subtracted from TLAND to get an initial estimate of TIG which is then given to LEMPREC to advance the state vector for use by the Ignition Algorithm. The direct cause of the problem with the run was that the large erroneous GUIDDURN when subtracted from TLAND put a negative time in TDEC1 for the call to LEMTEC. (See MPT/IL Flow Chart FC-3900 Sh3.)

Comparison of the numbers found in GUIDDURN (which is DP) and in adjacent locations with the Fixed Memory map in the program listing showed that the contents of this bank, 32, were shifted up one address. V91 (SHOW-BANKSUM) was executed and this indicated that R1 and R2 agreed which is basically what we check. R3, however, contained the listed content of the next to last location rather than the Hugh Blair - Smith Constant or CKSM - Bank 32 being a completely filled bank. A check of the first address in Bank 32 showed it loaded with the Hugh Blair - Smith Constant.

The size of the Luminary Program requires the PAC Tape to be spooled on 3 reels and for some time the PAC load has been made in reverse order of reels. Bank 32 was the first bank off reel 3. Apparently it is possible for the PAC S Register (local address pointer) to start at 2001_8 instead of 2000_8 at the very beginning of a loading operation.

Date _____ NASA APPROVAL

Then in a case such as this of a complete bank, when the counter loads the normal last location, 37778, there is still another word on the tape before the Stop character frame. Incrementing the S Register now returns it to 2000, so the last word on the tape, the Hugh Blair-Smith Constant, (CSUM) goes into this location. In informal discussion of this situation with Hugh, he indicated that the result of the sum-check might or might not be successful depending on the values actually involved and thus, how overflows rippled through the additions.

That any operation was obtained is felt to be due to the fact that Bank 02 contains Flight Programming rather than service routines. (Actual Log Sections involved are Controlled Constants, AGS Initialization, P20-P25, The Lunar Landing (P63), P70-P71, Lunar Landing Guidance, and Servicer.) P63LM was the first location (32,3000) accessed and by happenstance content of this location after the shifted load was a constant (RR29GAIN) from the end of the P20-P25 area which had the machine equivalent value (50655) to an XCH to a location in VAC 5. This was harmless and let the program continue into P63 a short way. Prior to hanging up in integration, the address pointer (P63ADRES) and the initialization of the thrust level for the DV Monitor were erroneously set by this problem and would have eventually bombed out something.

In this vein it is felt that this sort of effect may have been involved in problems experienced occasionally in the past. At that time, Reel 1 was loaded first and the first bank punched on reel 1 is Bank 02, the first of the two Fixed-Fixed banks. The general problem was that after the PAC was loaded and when it was attempted to start the LGC, numerous restarts would occur. DSKY control would not be achieved. The problem was "cured" by reloading and attributed to the PAC. Eventually, the reel load sequence was changed and this trouble has not been seen since. Now note that Bank 02 contains the Interrupt Loadins at its start and in particular the first four locations are where the hardware transfers to at the GO Sequence to start the LGC executing program. Also note that at least until recently Bank 02 has not been a completely filled bank so that if the loading offset described above occurred the first location in the bank would be loaded with 17777 - a TCF to 7777 - which is what is punched in unused locations on the PAC tape. Location 7777 is similarly loaded (17777) so at the start the LGC would go to the head of Bank 02 (location 4000) be TCF'd to 7777 where it would do TCF's to itself until the TC Trap hardware test would cause a Restart. The Restart also executes the hardware GO Sequence which would again transfer to the head of Bank 02 and so on.....!

Note that in this case the problem would be with a bank containing service routines. DSKY control was never achieved and so LGC—executed bank summing could not be done to reveal one way or another by that means that there was a bad load.

RECOMMENDED ACTION

1. Investigate operation of the PAC at the initiation of a loading sequence to determine possible cause of offsetting the loading of the first bank in.

2. Institute the fixed memory loading and verification sequence for the PAC - LGC shown in the attached flow chart. Comments on the verification flow chart, follow.

   a. The test on the PAC of the CKSM's vs their addresses should pick up a misalignment such as discussed in this report. Note that some misalignments could prevent LGC operation so that a check should be done before attempting to start the LGC. A tape compare could be done, but this is a time consuming operation. It is felt that the arrangement here permits the loading to progress as rapidly as possible.

   b. The V5M1 displays in V91 show the actual bank sum in R1 and the bank number in R3. They may compare true/true or not/true. Apparently either of these conditions in themselves does not assure a proper load in a bank. The true or not condition in R1 should be checked with the MIT/IL table as well as the content of R3.

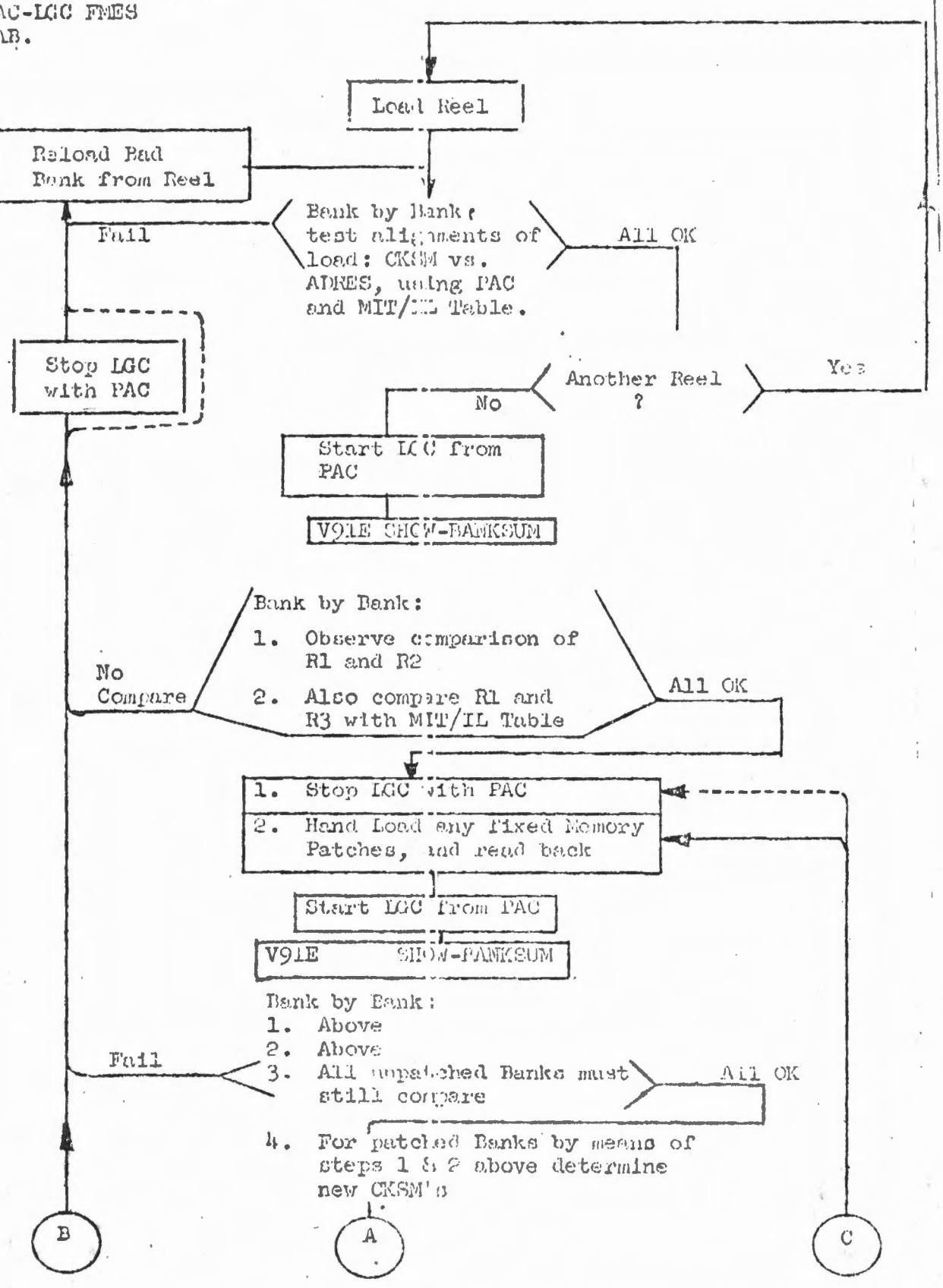
   c. Until a table such as requested in Recommendation 3. is available, GAC should prepare a table of the Bank No's, the CKSM addresses and their contents.

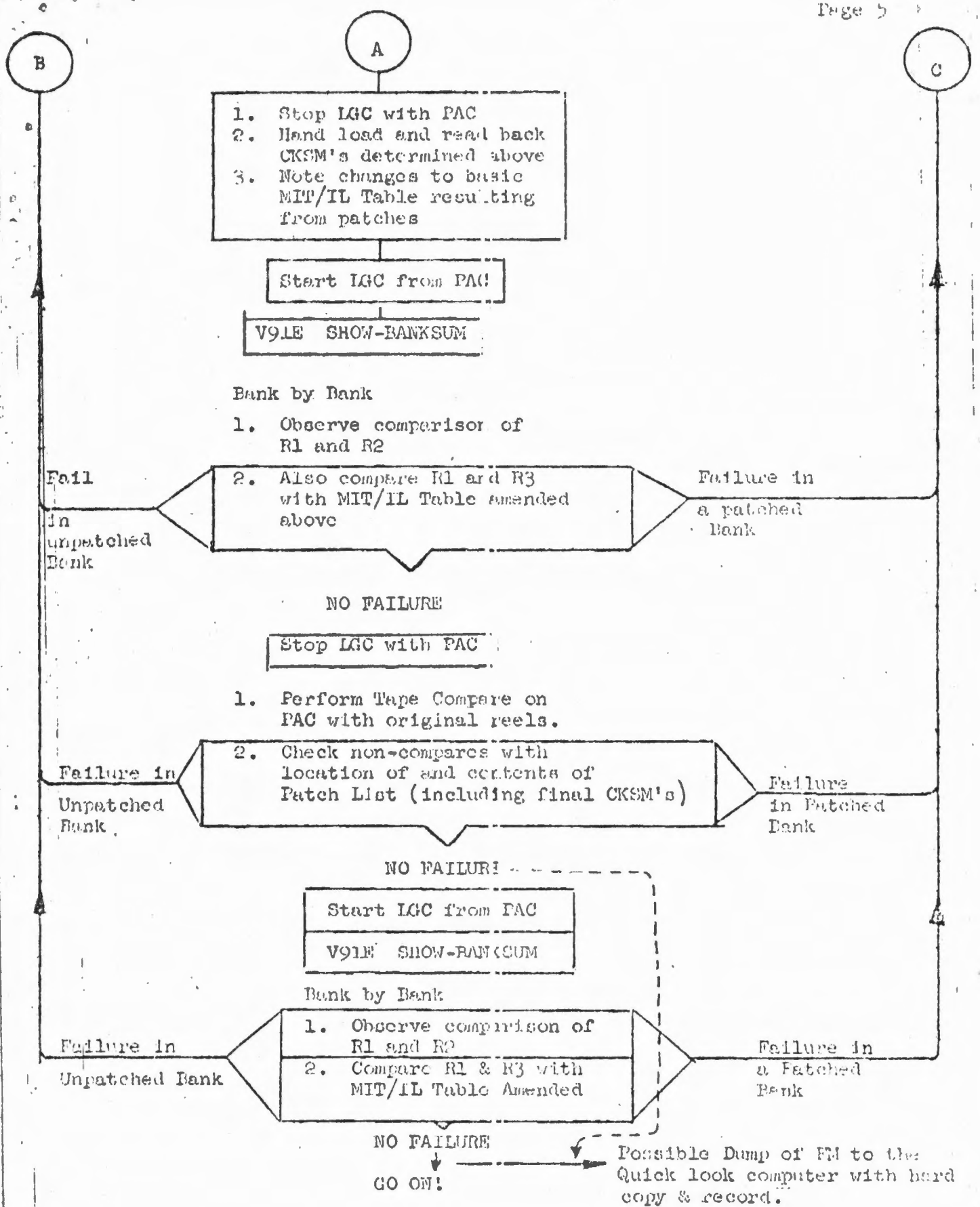
   d. The more lengthy tape compare is done once at the end where it should show only the properly placed Fixed Memory Patches. This is a comprehensive check that these patches are in their proper locations and that no other locations have been disturbed in the process.

   e. If a hard copy record dump is desired it could be done after the tape compare or after the last V91E SHOW - BANKSUM check. The former is probably preferable since this must be done with the LGC off (under PAC control) and the last V91 is basically a final check that the F Memory with the LGC running is properly loaded.

3. Recommendation 2 requires checks using a table supplied by the MIT/IL as a part of the Program Listing. This table would contain the same information now supplied by them in the Master Deck (not supplied to GAC.) This information is a list, bank by bank of the addresses and content of the CKSM's and the result of the bank sum, that is the content of R1 in SHOW - BANKSUM. While the first information could be tabled by hand from the present listing, the content of R1 cannot. A machine listing is desireable and simple to obtain and it is therefore recommended that NASA direct the MIT/IL to add it to the Program Listing.

FLOW CHART - Fixed Memory Loading and Verification For PAC-LGC FMES FOI LAB.




B
A
C
1. Stop LGC with PAC
2. Hand load and read back CKSM's determined above
3. Note changes to basic MIT/IL Table resulting from patches
Start LGC from PAC
V91E SHOW-BANKSUM
Bank by Bank
1. Observe comparisor of R1 and R2
2. Also compare R1 and R3 with MIT/IL Table amended above
Fail in unpatched Bank
Failure in a patched Bank
NO FAILURE
Stop LGC with PAC
1. Perform Tape Compare on PAC with original reels.
2. Check non-compares with location of and contents of Patch List (including final CKSM's)
Failure in Unpatched Bank
Failure in Patched Bank
NO FAILURE
Start LGC from PAC
V91E SHOW-BANKSUM
Bank by Bank
1. Observe comprison of R1 and R2
2. Compare R1 & R3 with MIT/IL Table Amended
Failure in Unpatched Bank
Failure in a Patched Bank
NO FAILURE
GO ON!
Possible Dump of FM to the Quick look computer with hard copy & record.

IOA2 # 3	8.3	"	Pulse-out in P63
IOA2 # 4	8.3	"	Pulse-out in P63
RHI # 1 (Mar 6)	7.7	A.to P66	Pulse-out P63 LOC displays wrong vel. in P66
RHI # 2	7.7	A.to P66	Small pulse-out in P63, otherwise steady nom.
[illegible]	4.0	A to P66	Nom.
RHI # 3 (Mar 6)	0%	A.to P66	
IOAI # 5 (Mar 2)	0%	A.to P66	C. T, Harmonic Patches

TLOSS LANDINGS (LIM 131 Rev 1)

Run ID	% TLOSS	Type of Run	Comments
MOAI #1 (Mar 2)	10	Man P66, hovered ~40 ft 100 ft	31201 Alarms only on displays or extended verbs. R3 in N60 > -200 ΔH = +234 ft @ TO. Pulse-out in P6
MOAI #2	10	Man P66 hovered	31201 Alarms on displays Landed at LGC alt of > -300 ft Pulse down in P63
MOAI #3	10	Man P66 @ 5K, Cruised	Two Pulse-outs in P63
"	10	Man P66	Two Pulse-outs in P63 C Tillman's failure.
MAI #1 (Mar 3)	8.3	" to P66	
MAI #2	8.3	"	Pulse-out in P63
MAI #3	8.3	"	
MAI #4	8.3	"	Pulse-out in P63
MOA2 #1 (Mar 4)	8.3	"	Pulse-out in P63
MOA2 #2	8.3	"	