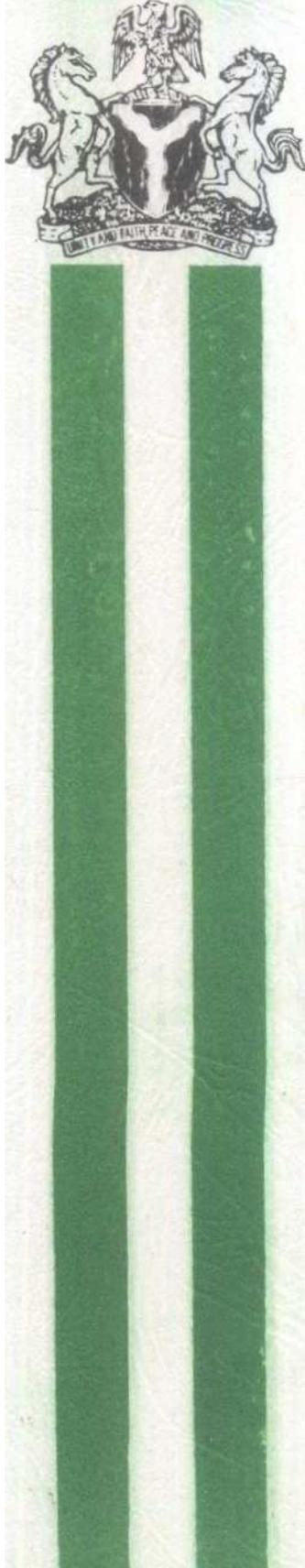


C IVIL AVIATION ACCIDENT

Report No. 04/350



Federal Republic of Nigeria

Ministry of Aviation Air
Transport Headquarters 14
Broad Street Lagos

REPORT ON THE ACCIDENT TO THE
DASSAULT AVION FALCON 20F
REGISTERED 5N-EPN, ON RUNWAY
19R AT MURTALA MUHAMMED AIRPORT
ON THE 5TH SEPTEMBER 1995.

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SYNOPSIS

The accident occurred on the Runway 19R when the aircraft landed with a non-deployable left main landing gear. All efforts made by the crew before landing the aircraft to get the gear deployed were futile. The aircraft eventually touched down with a crosswind landing technique holding the right wing low. The left wing came down at about two-thirds of the runway and the aircraft veered off to the left and ran into the runway shoulder before coming to a rest with a collapsed right main landing gear at about 21 m from the edge of the runway.

1. FACTUAL INFORMATION

1.1 History Of The Flight

The aircraft had a night stop at Port-Harcourt International Airport, after being on ground for 23hrs. It departed from Port-Harcourt at 0637 UTC on Tuesday the 5th of September for Lagos with eleven (11) souls on board and fuel endurance of 2 hours 50 minutes.

The take-off was normal, but after passing 1500ft when the "after take-off" checks were in progress, it was found that there was a red landing gear warning light indicating that the left main landing gear was not properly closed.

The crew recycled the landing gear twice but the problem persisted. A third recycling was carried out with the landing flaps extended to 10 degrees. After this, the warning light went off and the flight continued normally cruising at flight level 220.

The aircraft commenced its initial descent at about 0715 UTC leaving IL 220 for 1•L 120. On arrival over Lima Gulf VOR at about 0720 UTC, the aircraft was cleared to 11_50 with a speed below 200 knots and held in holding pattern for about ten(10) minutes. The aircraft was then cleared for an ILS approach into runway 19R. Close to the localiser intercept, the gears were lowered and the landing gear indicators showed that the gears were not deployed.

The indications were 2-GREENS (nose gear and right main gear) and no indications whatsoever on the left main landing gear. The landing gears were recycled, but it made no difference. The crew then proceeded to the area west of the field, climbed to 5000ft and carried out the "Emergency and Abnormal checklist"-Landing gear will not extend (Procedure B). Numerous attempts of this procedure were made but the result was an indication of 3-RED lights 2-GREEN lights. The final configuration of the landing gear were as follows:

Nose wheel ----- Down
Right main landing gear-----Down
Left main landing gear-----Up

The crew co-ordinated all efforts with the ground maintenance personnel including carrying out a low fly past for a visual observation of the landing gears. The crew also tried side-slipping the aircraft to shake the left landing gear down, but with no positive result. However, the crew did not pull 'G' forces to jerk the gear down.

An emergency was declared and after burning the fuel in the main tanks a landing was made with the two gears extended. The aircraft touched down and veered to the left side of the runway and ran into the runway shoulder before finally coming to rest at 0840 UTC. The accident occurred on Latitude N 0634.5 and Longitude E 03 19.1 at day time.

1.2 Injuries To Persons

No injuries were sustained by all the souls on board.

1. Damage To Aircraft

The nose-wheel gear door and the two main landing gear doors were seriously damaged. The starboard main landing gear collapsed, while the port wing outboard slats and leading edge, with its flap assembly were seriously damaged. The starboard wing outboard slats and inboard and outboard flaps were all destroyed. The belly center section and the portside wing-tip fairing were also crushed.

1.4 Other Damage

Two runway lights E 1182 and E2/82 were broken and some electrical cables were pulled from their

1.5 Personnel Information

The Pilot-in Command was a 32 year old Nigerian male with a Nigerian issued Airline Transport Pilot Licence Number 4078 valid until 1st February, 1996 He had his Part 1 ratings on Falcon 20 and Twin Otter. As at the time of the accident, the commander had accumulated a total flying experience of 3200 hours of which 750 hours were on type. The commander was qualified to take the flight.

The First Officer who is also qualified as a commander was a 47 year old Nigerian male with a Nigerian issued Airline Transport Pilot Licence Number 1562 which was valid until 25th December, 1995. His Part 1 ratings are PA-23, PA-31, F-28, Twin Otter and Falcon 20. The First Officer had a total flying experience of 8700 hours out of which 800 hours were on type. He was found qualified to take the flight

1.6 Aircraft Information

1.6.1 General Information

Type: Dassault Avion Falcon 2CF

Registration: 5N-EPN

Serial No! 273

Manufacturer: Dassault Aviation, France.

Owner: Tania Air System S. A.
W ickhams Cay Road Town
Tortola
P. O. Box 146
British Virgin Islands

Lessee: Elf Production (Nig.) Ltd;

Operator. Aero Contractors (Nig.) Ltd;
P. M. B. 21090
Murtala Muhammed Airport
Ikeja, Lagos.

Year of Manufacture: December, 1972.

C of A Validity: 20th May, 1996.

Airframe Time: 9957.32 hours

1.6.2 Engines: Two (2) General Electric

Type:	CF 700-2D2	
	No. 1	No. 2
Serial No:	304-47 I B	304A02B
TSN:	5304 hours	5292.3 hours
TSO:	2412 hours	2466.3 hours
Cycles;	5050	4984

1.7 Meteorological Information

When the aircraft was in contact with Lagos Approach, the 0800 UTC weather was passed on request follows:

QAM:	0800 UTC
Wind:	Calm
Visibility:	500M
Weather:	Bk N240m
QNY:	Slight rain
Temp:	24.121 degrees celsius
QFE:	1012HPA, 29.88 Ins
QNH:	1014HPA, 29.94 Ins

The trend landing forecast for MMA from MGT at 0830 UTC just before the accident was:

QAM:	0830 UTC
Wind:	Calm
Visibility:	9 Km
Weather:	B K N240
QNY:	Nil
QFE:	1012 HPA, 29.88 Ins
QNH:	1014 HPA, 29.94 Ins

It is obvious that the weather conditions had no significance on this accident.

1.8 Aids To Navigation

Navigational aids were not pertinent information to this accident though the ground aids were operating well.

1.9 Communications

Communication between the Control Tower and the aircraft was good.

1.10 Aerodrome Information

Runway 19R is 3900m long and 60m wide with all the navigational aids on it functioning properly. The aerodrome elevation is 135ft ASL.

1.11 Flight Recorders

Though the aircraft was equipped with both Cockpit Voice Recorder and flight Data

1.1 Wreckage and Impact Information

The aircraft was resting on its belly on the shoulder of the runway, 21 m away from the edge of the runway with the collapsed right main landing gear and nose wheel burrowed into the soft ground. Some metal chips were found on the runway. The chips apparently were those of the wing tips that touched the paved runway there were also skin wrinkles on the main undercarriage. This may be indicative of a

1.13 Medical and Pathological Information

No injuries were reported and there was no fatality. Therefore, no medical and pathological information were sought.

1.14 Fire

There was no fire outbreak since the substantial part of the fuel on board had been burnt off and the fire men had foamed the runway 19R before the landing.

1.15 Survival Aspect

The accident was survivable just because there was no fire.

1.16 Test and Research

After the aircraft was towed back to the hangar of the airline, the left main landing gear was stripped. It was found that the left main landing gear actuator bellcrank had broken off. When the 'D' ring was pulled off, the doors and the left main landing gear were found unlocked. The actuator bellcrank was therefore removed and taken to the facilities of DASSAULT AVIATION in Paris (APPENDIX 1) for Metallurgical examinations and the result were as follows:

1. The metal lographic examination of the fractured surface did not indicate any defect in the material or manufacturing process.
 2. The failure of the actuator bellcrank was initiated in its inner angle near the fractured area.
 3. The microscopic examination of the fractured surface revealed series of striations which were characteristic of fatigue crack propagation.
 4. There was an indication of interference between the actuator bellcrank and the bellcrank
- 1.17 Additional Information

2. No additional information. ANALYSIS

The most significant indication to the cause of this accident was the structural failure of the left main landing gear actuator bellcrank. The crew was not aware of this problem until "after take-off checks" were in progress when the red light indicator for the left main landing gear door was on. The red light only went off after a series of recycling of the left main landing gear.

This implied that the hydraulically operated actuator bellcrank was already malfunctioning and hence the actuator mechanism could not close the landing gear door after the take-off. The series of landing gear recycling might have contributed to the failure of the bellcrank. This was also evidenced during the landing phase of the aircraft. When the gears were lowered only two (2) green lights were indicated (nose wheel and right wheel doors opened) with no indication whatsoever on the left door. No amount of recycling of the left main landing gear could deploy the door until its mechanism was manually unlocked in the hangar and hence, the red light came on.

All this scenario confirmed that there were some sort of malfunctioning of the door opening/closing mechanism of the left main landing gear which was later traced by this Bureau to the broken actuator bellcrank. The flight crew identified its problem early enough as "landing gear will not extend" as stipulated in the Recurrent Training Manual of the aircraft. While the crew promptly carried out the "Emergency and Abnormal Checklist" Procedure B, this Bureau was of the opinion that Procedure A* should have been carved out as outlined in the flight Safety Manual (Appendix 11).

The final landing configuration of the aircraft were as follows: Nose-wheel Down Right
wheel Down Left
wheelUp

This indicated 3 Red and 2 Green lights which falls under Procedure Ax in the manual. But the crew carried out Procedure B which obtains for a landing configuration of:
1, 2, or 3 Red lights and no Green

And obviously that was not the landing configuration of the aircraft.

The research carried out on the bellcrank revealed that the mere opening and closing of the main landing gear door could not in itself lead to the fatigue fracture of the actuator bellcrank without an interference from an external body which was identified to be the bellcrank structural stop. The interference was evidenced by the formation of metal chips on the contact surface of the structural stop and an induced stress from the stop on the actuator bellcrank. This interference could only have been caused by an improper rigging of the door actuator push-rod carried out on 8th March, 1990; and the next check would be due in 1996. If the rod was improperly rigged, then the improper rigging of the push rod caused the crack and the presence of striation lines on the fractured surface indicate the number of recyclings of the landing gear after the crack was initiated.

CONCLUSIONS

3.1 Findings

- 3.1.1 The aircraft was properly registered and certified in accordance with the Civil Aviation Regulation of Nigeria.
- 3.1.2 The flight crew was certified and qualified to fly the aircraft that morning of the accident.
- 3.1.3 As at the time of the accident the aircraft was found to carry a Radar Antenna on its Deferred Defects List (Appendix III). And this was not a contributory factor to the accident.
- 3.1.4 Series of recyclings were carried out on the main landing gears and still the left main gear would not extend.
- 3.1.5 The crew correctly burnt off the fuel in the main tanks of the aircraft when a forced landing became inevitable.
- 3.1.6 The flight crew did not follow the Emergency Procedure properly as stipulated in the Flight Safety Manual.
- 3.1.7 All efforts made by the crew by side-slipping the aircraft for a probable release of the landing gear were abortive.
- 3.1.8 A detailed examination of the bellcrank at the laboratories of Dassault Aviation, France on the 26th September 1995 revealed a fatigue fracture of the actuator bellcrank of the left main landing gear (Appendix IV).

There was evidence of interference between the actuator bellcrank and the door structural stop (Appendix V).
- 3.1.10 There were striations on the micrographs of the fractured surface which were characteristic of fatigue failure (Appendix V).

3.2 Probable Cause

The accident was caused by the fatigue failure of the door actuator bellcrank of the left main landing gear due to an improper rigging of the door actuator push rod in the door mechanism.

4 **RECOMMENDATIONS**

(a) The landing technique at the time of this accident is highlighted for observation. Keeping the belly of the aircraft from making contact with the runway surface at high speeds is fully endorsed by the Accident Investigation Bureau.

(b) The possibility of forcing the landing gear to come down by pulling of "G forces' is worth noting.

5. APPENDICES

- I. Investigation on the main landing gear actuator bellcrank
- II. Flight safety manual of this aircraft
- III. Deferred Defects List on the aircraft at the time of the accident
- IV. The broken actuator bellcrank
- V. The arrow on the photograph shows the interference of the structural stop on the bellcrank while the big arrow shows the crack initiation (Fig. I)

Details of crack initiation zone (Fig. 2)

The micrograph showing series of striations which indicate fatigue failure of the bellcrank (Fig.3)



velizy le 29 septembre 1995

NIGERIAN ACCIDENT OFFICE

Télé. M/corresp: 40.83.22.10
Direction du Support des Avions Civils

Attention: M. D.O ADEOSUN

N/Ref : DSAC 95/IX-122DRC -YD/DF'

**Copies: M. ROUSSELOT - JE F MANAGEMENT
M. MOAL - Bureau Veritas
L. LAMARQUE**

Subject : Investigation on the stain landing gear actuator bellcrank PIN MY2023126911.

Dear Sirs,

The results of the investigations on the main landing gear actuator bellcrank performed by Dassault Aviation at Velizy on the 26th September 1995, are the followings

- o The rupture plan examination did not revealed any material defect or material manufacture process defect.
- a The rupture has been initiated in the inner angle of the bellcrank close to the damaged area. This damaged area is due to interference with the bellcrank structural stop. This interference has generated formation of metal chips on the contact surface of the
- o The plan of rupture was peened and oxyded which is characteristical of fatigue crack propagation.
- u This plan of rupture shows marks (stop lines) which can be explained by interruption (fl' operations due to maintenance or any other reasons.
- a The scores on this plan of rupture show that only opening and closing of the Nil .0 dool could not lead to such a fatigue developement. We assume that an unidentified to t., IL-i~ stress being caused by an improper rigging of the rod may lead to this defect
- zi Material analysis is in conformity with blue print specifications (i.c aluminium alloy 2017A).

Sincerely yours

Yvon DESVIGNES

Landing Gear Control Circuit Breaker IN

normal Gear Handle RECYCLE

gear, till will not retract. land using Procedure A

LANDING GEAR WILL NOT EXTEND

No 1 Hydraulic Pressure CHECKED

landing Gear Selector DOWN/CIRCUIT BREAKER IN

see Table 3-4 for hydraulic system indications

TABLE 3-4 HYDRAULIC SYSTEM INDICATIONS

HYDRAULIC SYSTEM		INDICATIONS	PROCEDURE
No 1 Normal	No. 2 Normal	No Indication	A
No 1 Normal	No. 2 Normal	3 Red, 1 or 2 Green	A\$
No. 1 Normal	No. 2 Normal	1, 2, or 3 Red, No Green	B
No 1 failed	No. 2 Normal	-	A
No 1 failed	No. 2 Failed	-	C

if procedure A is unsuccessful, push the emergency gear handle in and proceed with Procedure B.

NOTE

if the normal landing gear selector cannot be placed down, antiskid will not operate. Add

Procedure A

No 1 Hydraulic Pressure CHECKED

landing Gear Control Circuit Breaker IN
 Landing Gear Selector Circuit Breaker OUT
 Normal Gear Selector, DOWN

Emergency Gear Handle PULLED

indications GREEN
 THREE RED/THREE

NOTE

Landing Gear Selector Circuit Breaker IN

This energizes the normal landing gear circuit breaker and permits gear retraction using available transfer Wk power if a go around is necessary

Procedure B

No 1 Hydraulic Pressure CHECKED

landing Gear Selector Circuit Breaker OUT

RECURRENT TRAINING MANUAL

Normal Gear Selector.....

DOWN Landing Gear and Down _ manually UNLOCK

Emergency Gear Handle PULLED

No. 2 Hydraulic Pressure:..... checked

Indicators ... _ three RED / THREE GREEN

NOTE Landing Gear Selector Circuit Breaker:alter.....
IN

TU energises the normal landing gear circuit breaker and permit gear retraction us" available transfer jack power if a so around is necessary

procedure C

Airspeed 160

KNOTS Landing Gear Selector circuit

Breaker.....I..... OUT Landing Gear

Selector..... .. DOWN

Left gear extension

- Slip % bail which left_ rudder right.
 - manually unlock left door and gear
 - Maintain slip 30 seconds.
 - maximum slip. fall left rudder increase speed until left gear is down. check left green direction. manually unlocking the right door and gear
- Name section extension

None Gear and Door MANUALLY UNLOCK

indicator NOSE GEAR-CHECK RED

Airspeed..... INCREASE UNTIL GEAR DOWN

indication NOSE GEAR-CHECK GREEN

GENERATOR LIGHT ON (SWITCH ON)

Volmeter (28.5 Volts is normal.)..... SELECT FAILED GEN IF

voltage is zero attempt maximum of two resets.

if reset is unsuccessful

Faulty Generator Switch OFF

U voltage is readable (generator with 28.5V is normal):

Faulty generator Switch OFF

generator voltage newly *.a) due to 1". after . a cooling pu period attempt reset and manual

voltage with carefully Load on Operating Generator LIMIT IAS above

170 Knot 300 AMPS MAX IAS below 170

Knots..... 200 AMPS MAXIMUM

aero contractors company of nigeria ltd.

APPENDIX W

DEFERRED DEFECTS

DEFERRED DEFECT DETAILS

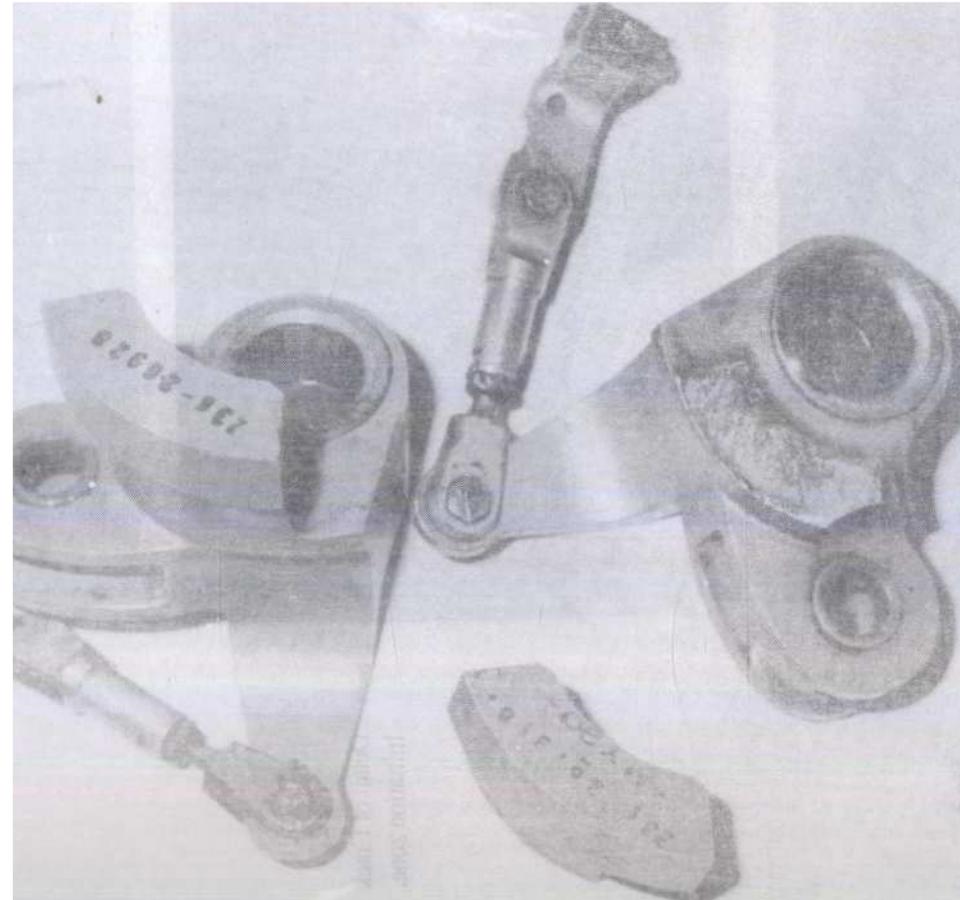
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Photograph showing the broken actuator bell crank



APPENDIX V

--+ Impact of structural stop with formation of metal Chips.

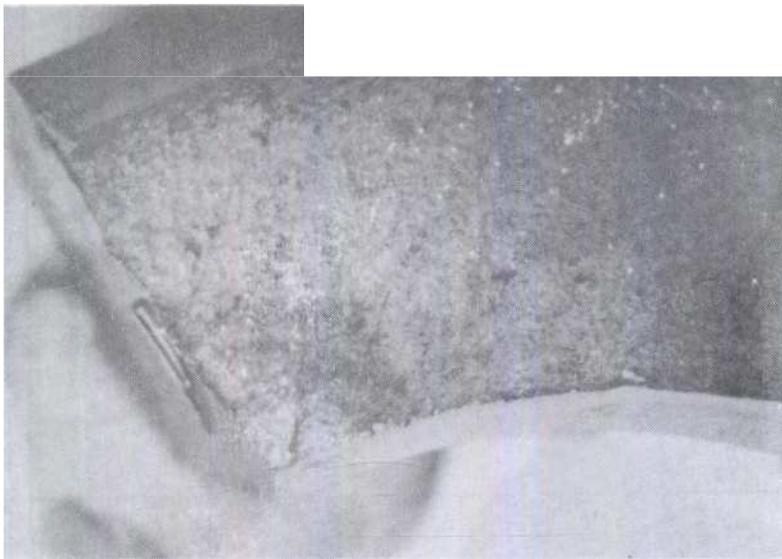


Fig 2 Detail of Crack Initiation zone.

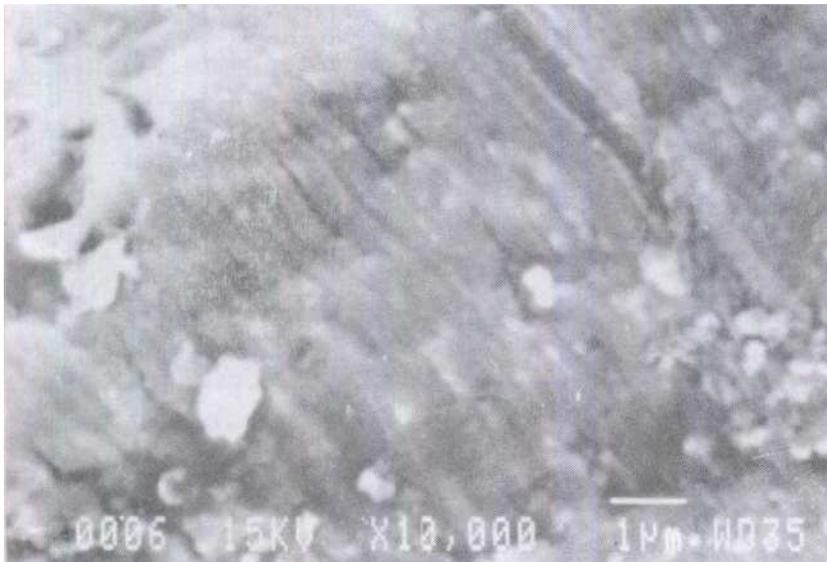


Fig 3 Characteristic aspect of Fatigue propagation.

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