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(NASA-CR-171163) SURFACE ANALYSIS OF SPACE TELESCOPE MATERIAL SPECIMENS Monthly Report (Auburn Univ.) 70 p HC A04/MF A01 CSCL 03A

N84-34351

Unclas
G3/89 24046

SURFACE ANALYSIS OF SPACE TELESCOPE MATERIAL SPECIMENS
(NAS8-35914)

Monthly Report for July
(July 31, 1984)

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Abstract

Surface analysis by electron spectroscopy for chemical analysis (ESCA) was used to characterize a number of the samples during the past month. With ESCA, the sample is irradiated with monoenergetic soft x-rays and the resulting emitted electrons are energy analyzed to determine the binding energy of electrons to the surface atoms. The major peaks were used in the quantitative determination of the surface composition. (Please refer to Tables 1 through 16 which are interspersed with the figures.) The presence of trace elements (impurities below 1% atomic composition) was also detailed. Initially a survey scan was run for each sample to deduce the elemental composition. Then the major peaks of interest and those of the trace elements were individually examined. After this, the samples were argon sputtered to etch away surface layers, and then additional measurements were carried out in order to obtain depth profile information. Those species present only on the surface could in this way be distinguished from those having a significant depth distribution within the sample.

It was estimated on July 31 that the measurements were 90% complete. It is expected that the measurements will be 100% complete by August 30, 1984.

ESCA Data for Silver and Copper Specimens

Silver

Four silver samples have thus far been examined: a silver interconnect flown on STS-8, a silver foil flown on STS-8, the relevant control silver specimen for these samples, and a gold-plated silver foil which had been subjected to the plasma asher for a period of two minutes. Several common trends were found for all silver samples:

1. The flight and ashed samples exhibited a slight decrease in binding energy (0.1 to 0.3 eV) of the Ag 3d doublet relative to the control. (These data are given in Figs. 1, 2, 9, 21, and 22.) These results indicate an increase in the degree of oxidation of silver (viz., Ag ==> Ag_2O ==>AgO).

2. Chemical shifts toward oxygen species with lower O(1s) binding energies (B.E.) occurred in the flight and ashed samples. (These data are given in Figs. 5, 6, 11, 12, 17, 18, 23, and 24).

3. The control sample always had a Ag to O ratio of 1:1 at the surface of the sample. (These data are given in Tables 2, 4, 6, and 8. It should be pointed out, however, that this is not necessarily evidence that the chemical composition of the surface is AgO, although the data are consistent with this interpretation.)

4. A decrease in carbon was observed in the ashed and flight samples relative to the control. (See Tables 1, 2, 3, 4, 5, 6, 7, and 8.)

The ashing process, surprisingly, did not seem to simulate very well the processes which occurred during exposure to the ambient during flight. The flight samples exhibited shifts toward increased surface concentrations of oxygen at lower binding energies, but new chemical bonding forms were not observed. Figures 17, 18, 23, and 24 indicate only shifts between oxygen species originally present on the surface. On the other hand, the ashed samples exhibited not only this effect, but also the creation of new oxygen species at still lower binding energies (see Figs. 5, 6, 11, and 12).

Ashed and flight samples also differed in the silver to oxygen ratio. Whereas the control showed a 1:1 ratio, the ashed samples showed a decrease and the flight samples showed an increase in this ratio. The results are as follows:

Silver-to-Oxygen Ratios

Control Sample:	1.0
Gold-plated Silver after Ashing:	0.2
Silver Foil after Ashing:	0.4
Silver Foil after Flight:	2.5
Silver Interconnect after Flight:	1.5

The gold-plated silver sample deserves special mention due to the unusual effect of the plasma asher treatment. Even the control sample exhibited a silver peak at the surface, which is rather surprising. (It would be expected that the gold plating would have entirely protected the underlying silver.) The ratio of gold to silver was found to be 4 to 1. After ashing, gold was barely detectable (see Figs. 3 and 4). Quantitatively it was found that the gold to silver ratio went from 4 to 1 before ashing to a ratio of 1 to 13 after ashing. Possibly this could have been due to a bulk diffusion of the gold into the silver foil during ashing. It seems unlikely that the gold was sputtered away, since the sample weight measurements by the Marshall personnel indicated no weight loss during ashing. Another possible explanation is that the adhesion of the gold to the silver was affected by plasma ashing, so that the gold aggregated into small beads, thereby leaving the silver surface exposed.

The composition of the silver interconnect and the underlying silver foil after flight were very similar (see Tables 6 and 8). However the control sample for the interconnect was found to have a larger amount of graphitic carbon. It was found that this carbon could be easily removed by sputtering. The flight interconnect had somewhat more carbon than the flight foil. The flight foil also contained sulfur and chlorine, elements not not found on the interconnect.

Copper

Cupric oxide was found on both the control and flight samples (see Fig. 27). The amounts of carbon and oxygen were less in the flight samples, as indicated below.

Oxygen-to-Copper and Carbon-to-Copper Ratios

	O/Cu	C/Cu
Control Sample:	5.2	5.9
Flight Sample:	1.1	3.8

A shift to lower binding energy oxygen was observed in the flight sample (see Fig. 28). The carbon type, however, was unchanged (see Fig. 29).

ESCA Data for Paint Specimens

Because the paint samples were non-metallic, some electrical charging occurred during the ESCA study. As a consequence, the positions of the peaks at times appeared as much as 6 eV higher than expected. This was more evident in the A-276 and the 401-C10 specimens than in the Z-302 specimen, the latter being scarcely affected by charging. The degree of surface charging depends not only on the low electrical conductivity of the sample, but also on the thickness of the specimen because this will control the rate of charge leakage to the underlying metal substrate. The consequence is that peak positions were inconsistent from sample to sample, and in addition, the peak positions were observed to change with sputtering of the sample. Therefore the energy axis of the ESCA scans should not be used to infer absolute binding energy, and the shifts in energy should not be used indiscriminantly to infer changes in chemical binding.

In view of the foregoing, it is not surprising that few consistent trends were found by means of ESCA for the paint specimens. Nevertheless, the A-276 and Z-302 samples did show a slight decrease in the silicon-to-oxygen ratio, while the 401-C10 sample exhibited a significant increase. The data supporting these statements are now given.

Silicon-to-Oxygen Ratios

	A-276	Z-302	401-C10
Control Sample:	0.48	0.29	0.13
Flight Sample:	0.30	0.19	0.88

For the A-276 specimens, the silica, oxygen, and carbon peaks were unaffected by flight, as indicated by comparison of the flight and control sample data (see Figs. 31, 32, and 33). For the Z-302 specimens, the silica peak was broader in the flight sample, and the peak was broadened by sputtering (see Figs. 34 and 35). No change occurred in the N(1s) or O(1s) peaks (see Figs. 36, 37, 40, and 41). Three forms of carbon were present on the Z-302 control. The flight sample exhibited a shift in one of the higher binding energy forms of carbon (see Figs. 38 and 39).

Although the peaks in the 401-C10 flight sample appeared to be shifted towards higher binding energy, this seems to be a consequence of a difference in the degree of charging of the flight and control specimens. Perhaps the thicknesses of the samples were not the same. Assuming this to be the case, there does not appear to be a difference in the oxygen species between the flight and control specimens (see Figs. 42 and 43). Two forms of silicon were present on the control specimen, with the higher binding energy form predominant. The flight sample, on the other hand, showed no lower binding energy form (see Figs. 44 and 45). The carbon peaks indicated a behavior resembling that of the Z-302 samples, namely, the flight sample exhibits a shift to a higher binding form relative to the control sample (see Figs. 46 and 47.

Sample: Gold-plated Silver / Ashed 2 min
Treatment:
Date: 7-31-84

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
AUF1	Ag(3d 3/2)	373.6		$2\times10^3/1$	20							
	Ag(3d 5/2)	367.6	318			~11,000	405575	4.056×10^7	15 Å	10.7	0.14	Ag
AUF4	Au(4f 5/2)	87.45	245	$1\times10^4/5$	200	[illegible]						
	Au(4f 7/2)	83.8	33[illegible]			~[illegible]	316000	3.16×10^6	16 Å	9.79	0.01	Au
AUF2	O(1s)	532.7	239	$2\times10^3/1$	50	~[illegible]			14 Å	2.85		
		530.[illegible]	290			~7500						
		[illegible]8.7	341			~[illegible]	440115	1.76×10^7			0.64	O
AUF3	C(1s)	288.[illegible]	117	$1\times10^3/2$	50				15 Å	1.00		
		286.3	198									
		284.3	249				585760	5.885×10^6			0.21	C

$\frac{Au}{Ag} - \frac{1}{13}$

Comments:

$\frac{Au}{Ag} \simeq \frac{1}{13}$

$\frac{Ag}{O} \simeq \frac{1}{5}$

Figures:

ORIGINAL [illegible]
OF POOR [illegible]

Table 1

Sample: Gold-plated Silver /Control
Treatment:
Date: 7-29-84

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
AUC 1	Ag $3d_{3/2}$	373.[illegible]		$1\times10^3/1$	20							
	Ag $3d_{5/2}$	367.7	314			7,500	256,000	1.29×10^7	15 Å	10.7	0.08	Ag
AUC 2	Au($4f_{5/2}$)	87.50	244	$1\times10^4/1$	50	4,800						
	Au $4f_{7/2}$	83.85	337			5,700	238,000	4.76×10^7	16 Å	9.79	0.30	Au
AUC 3	O(1s)	532.7	239	$5\times10^2/2$	20	3,600			14 Å	2.85		
		530.7	290			1 200						
							254,000	3.175×10^6			0.08	O
ATC 4	C(1s)	286.0	206	$2\times10^3/2$	50	1500			15 Å	1.00		
		284.4	246			6600		8.1×10^6				
							405,000				0.54	C

Comments:

$\frac{Au}{Ag} \simeq \frac{4}{1}$?

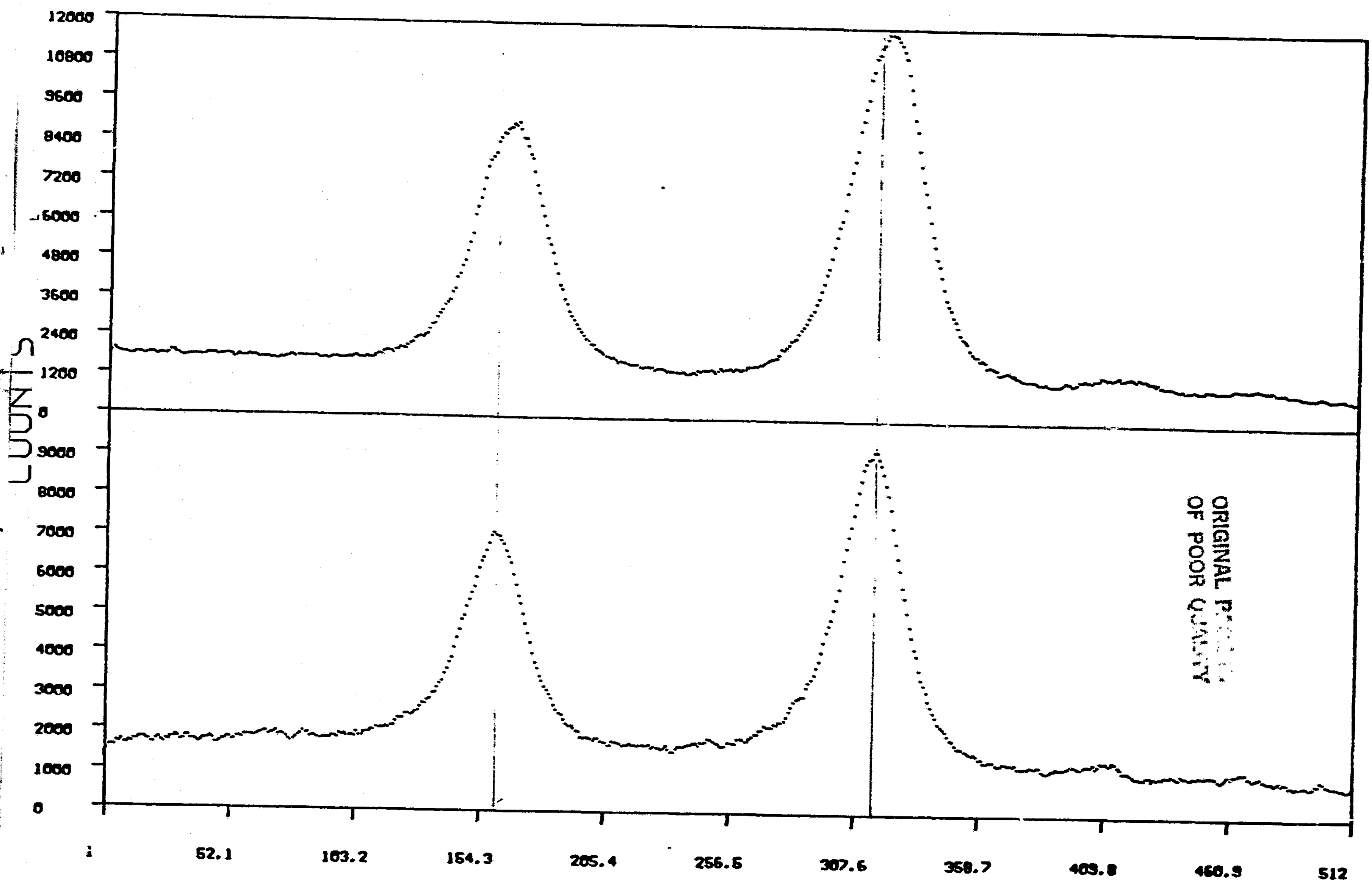
$\frac{Ag}{O} = \frac{1}{1}$

$\frac{Au}{Ag} = 3.7$

Figures:

Table 3

Au-PLATED Ag ASHED/CONTROL - Ag 3d 3/2 and 3d 5/2



CHANNELS

Fig. 1

AUF1
AUC1

Au-PLATED Ag ASHED/CONTROL SPUT.- Ag 3d3/2 and 3d5/2

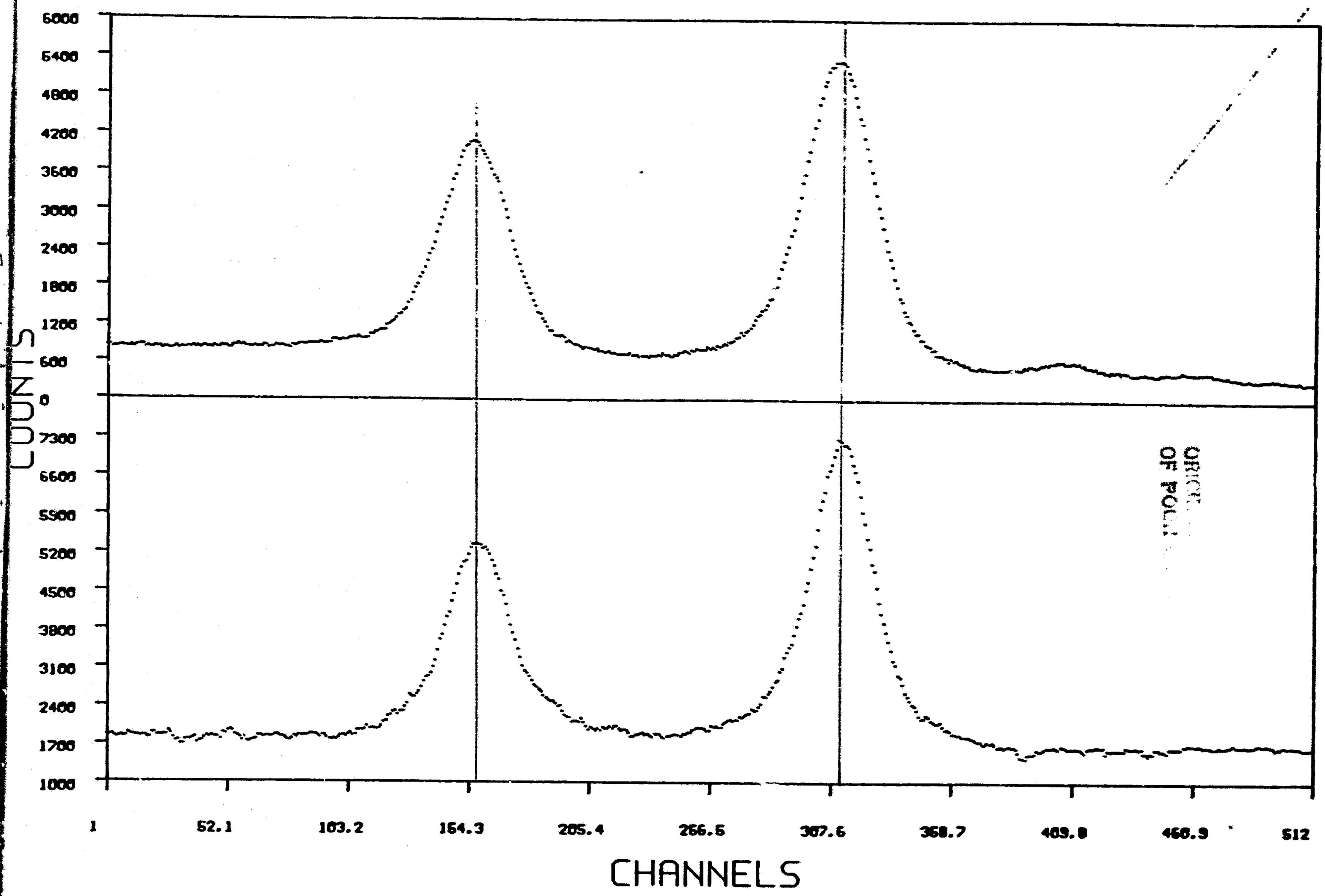
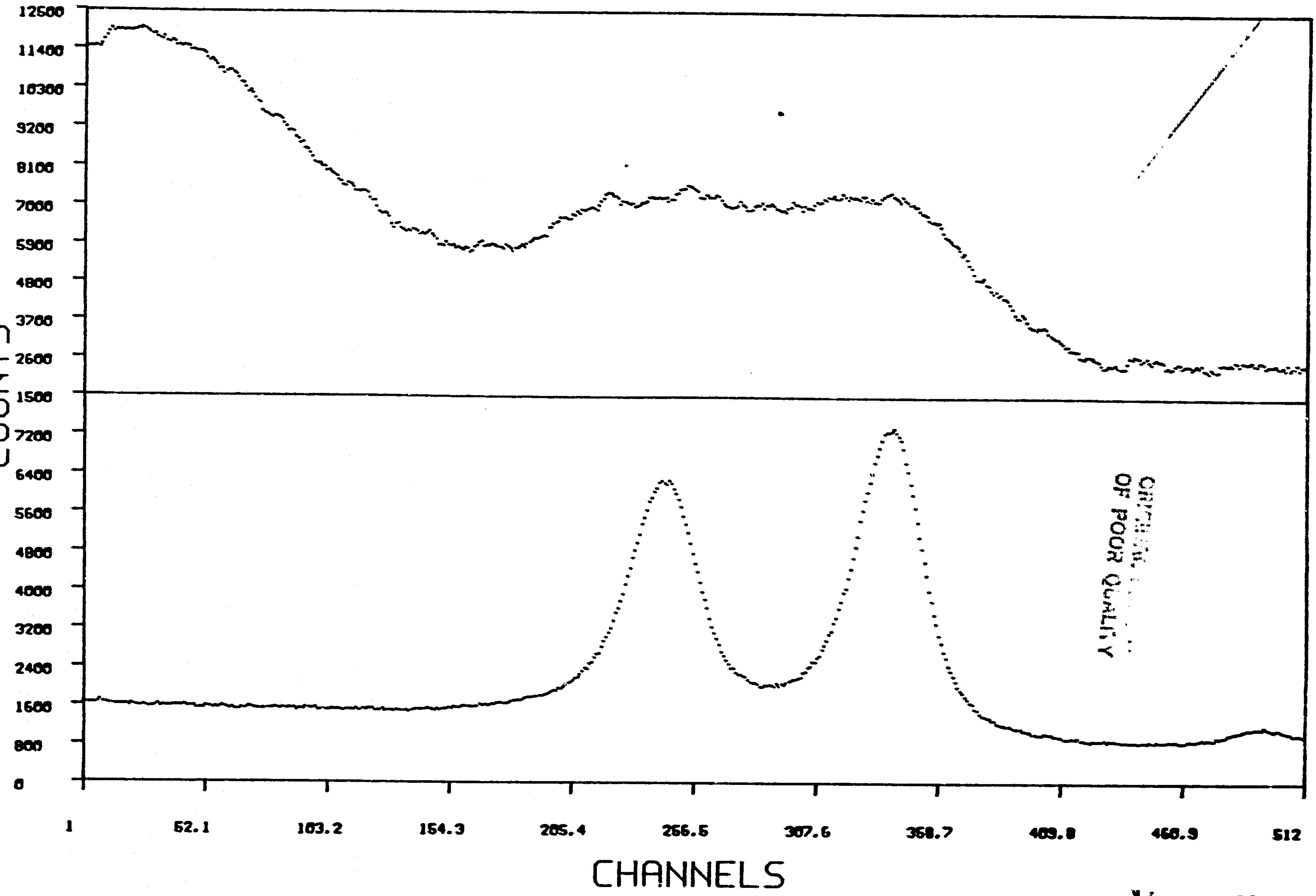


Fig. 2

Au-PLATED Ag ASHED/CONTROL - Au 4f 5/2 and 4f 7/2



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200 1X10⁴/5 AUF4

Au-PLATED Ag ASHED/CONTROL SPUT.- Au 4f5/2 and 4f7/2

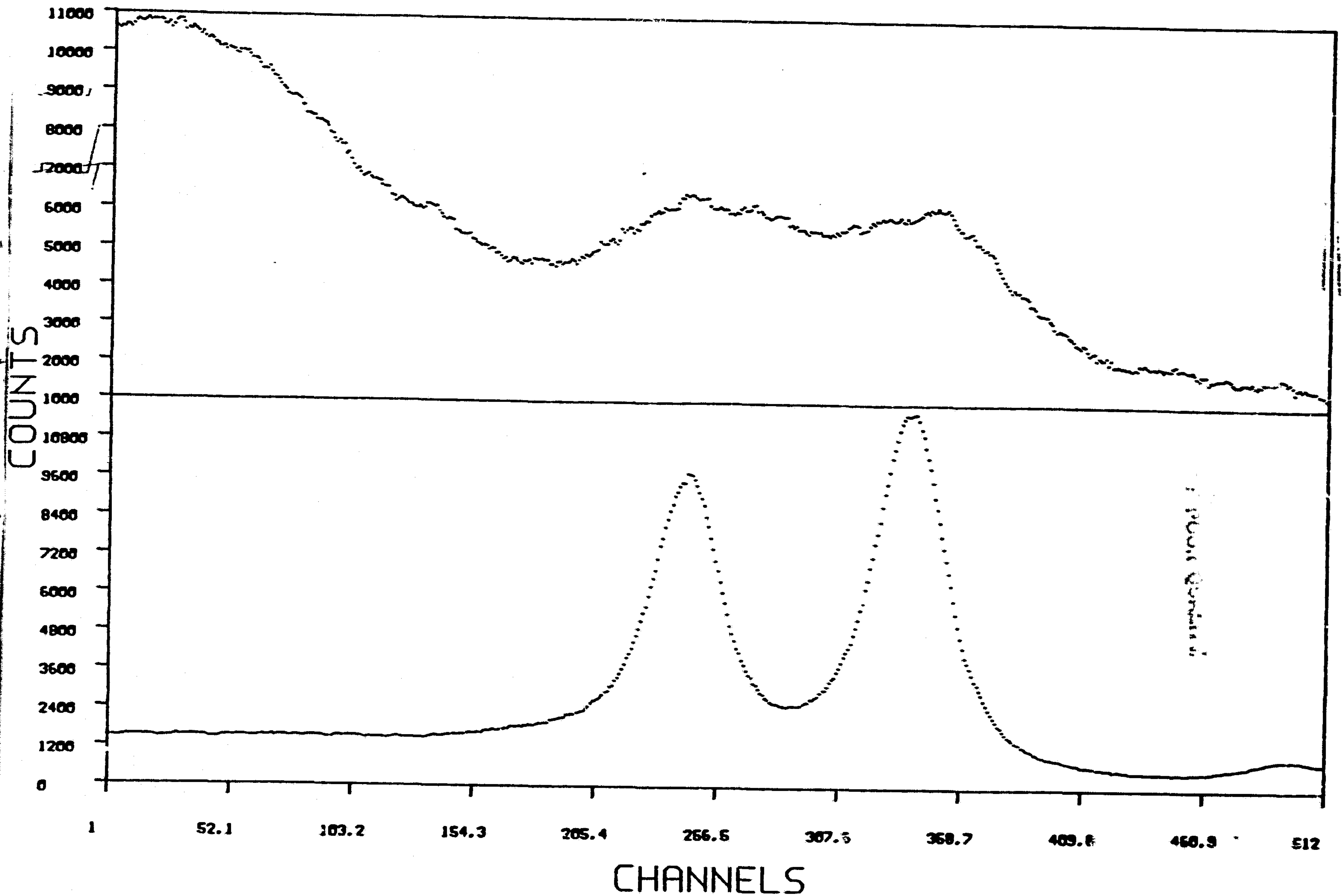
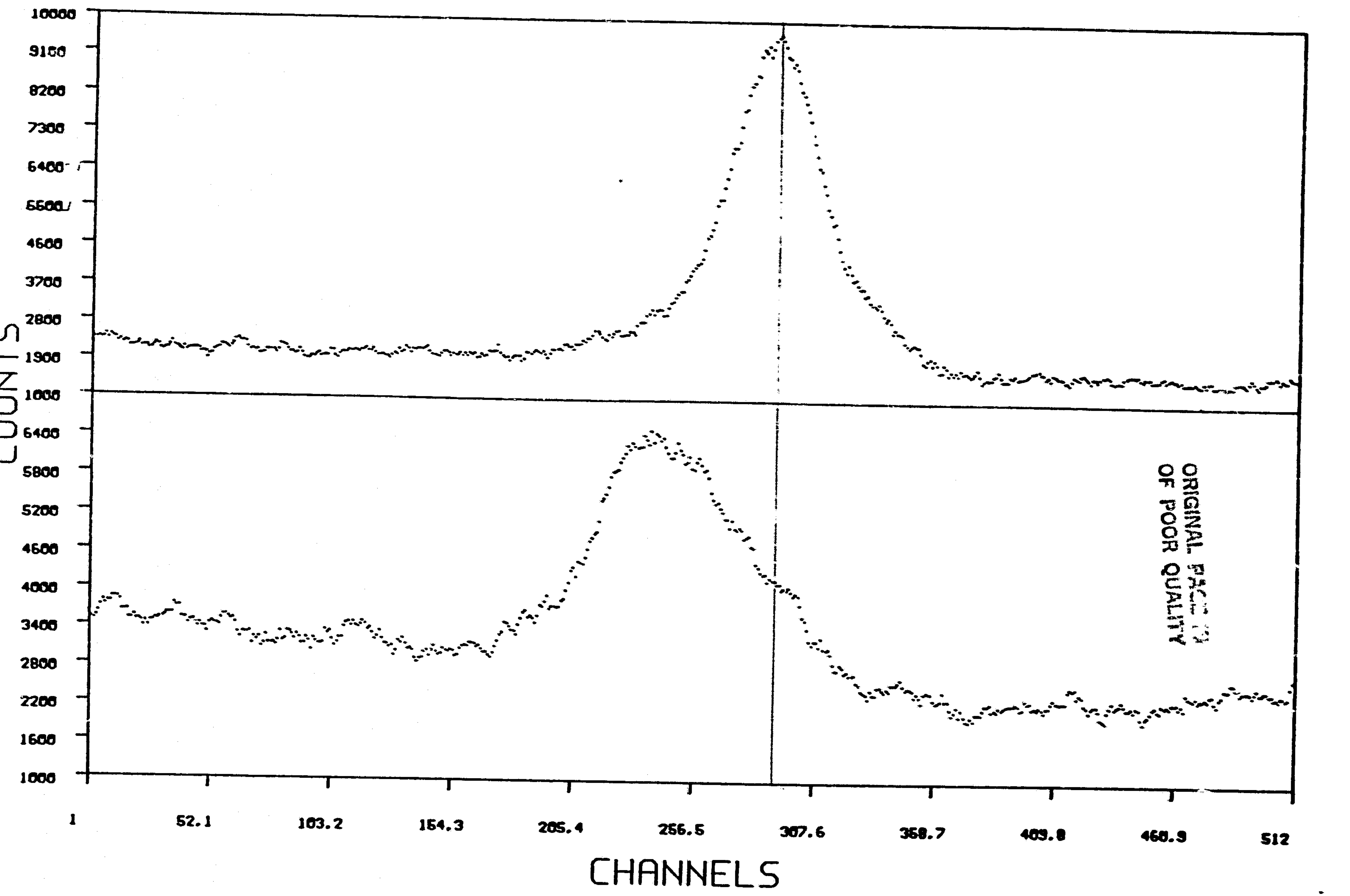


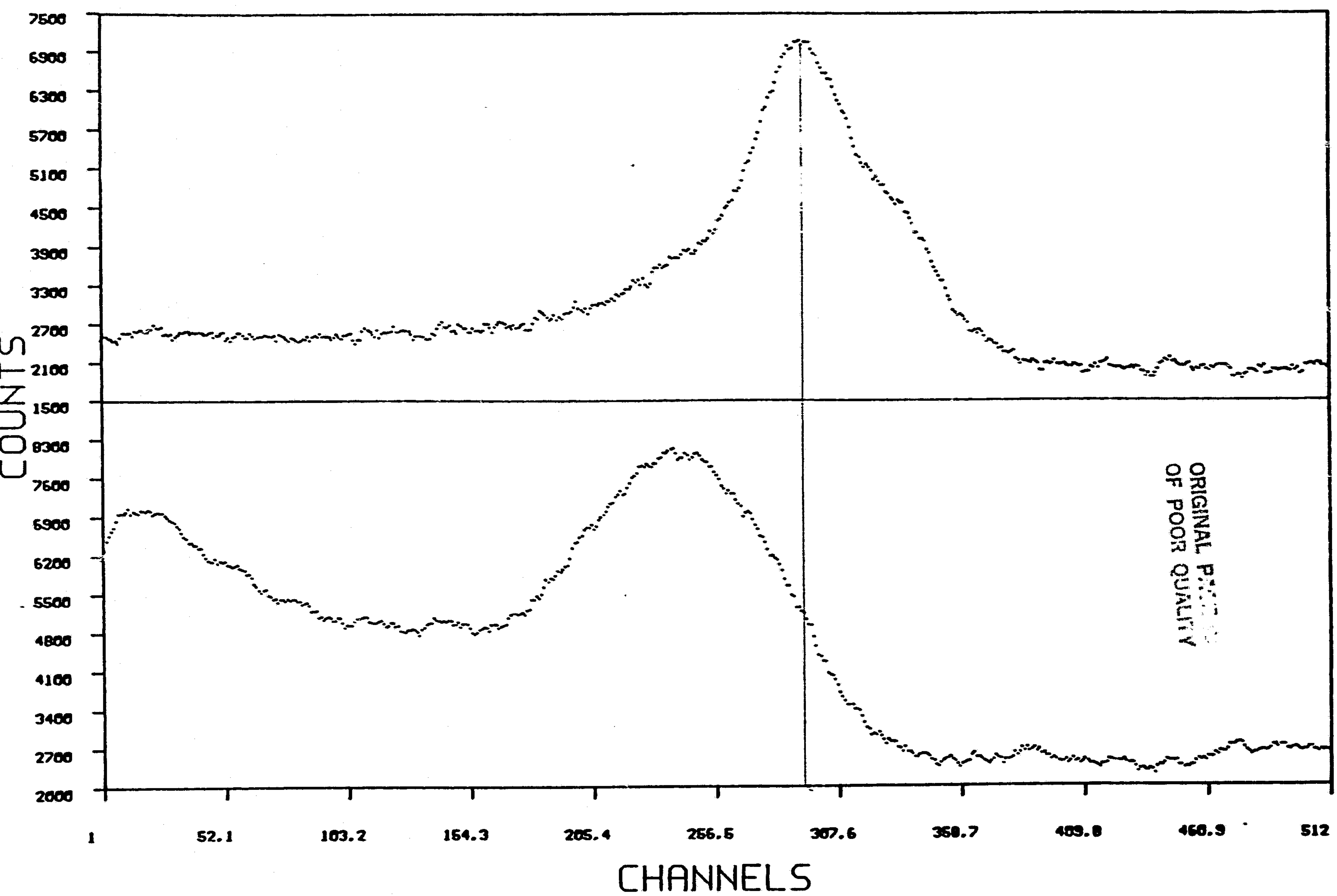
Fig. 4

Au-PLATED Ag ASHED/CONTROL - O 1s

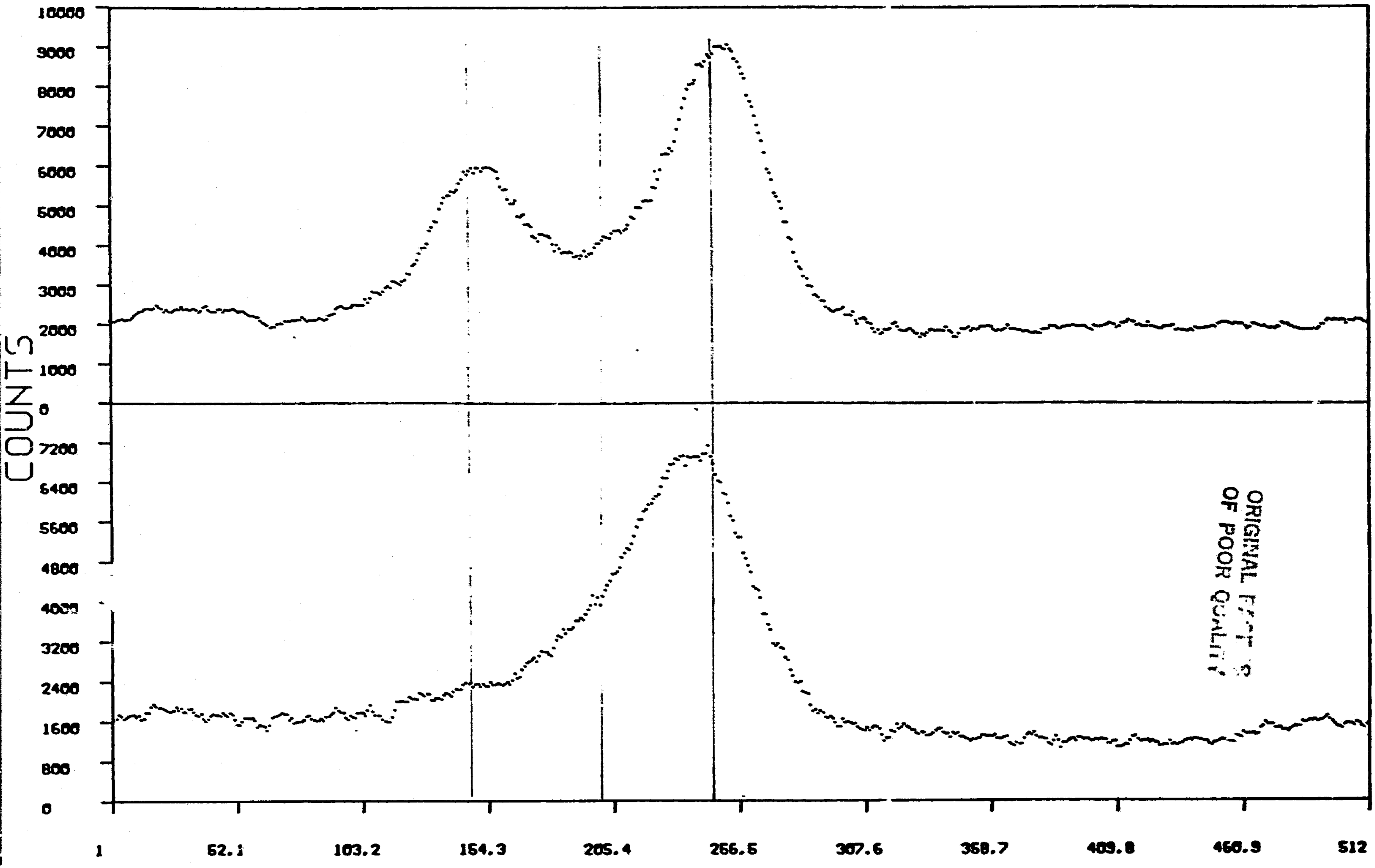


AUF 2

Au-PLATED Ag ASHED/CONTROL (SPUTTERED) - O 1s

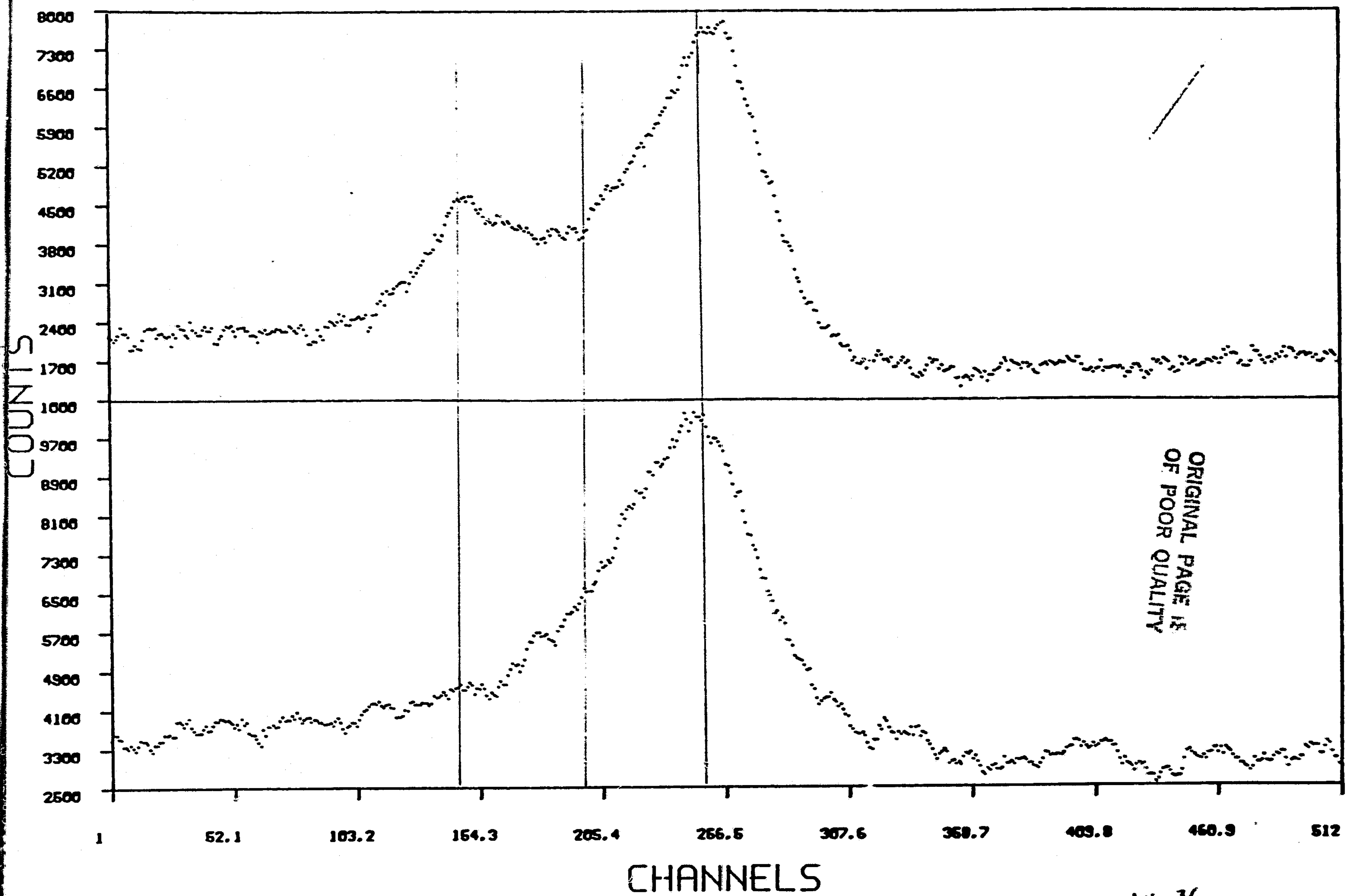


Au-PLATED Ag ASHED/CONTROL - C 1s



50 1X10 ½ AUF 3

Au-PLATED Ag ASHED/CONTROL (SPUTTERED) - C 1s



50 1X10^3/2 AUF7
50 2X10^3/S AUCLS

Sample: Silver foil . Ashed 60 s
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
AGA602	Ag3d 5/2											
	Ag3d 3/2	367.9	310.2	2X10³/1	20	2000	340,000	3.4x10⁷	15 Å	10.7	0.20	Ag
AGA601	O(1s)	531.[illegible]	28[illegible]	5x10³/5	50	[illegible]			14 Å	2.85		
		[illegible]29.8	333			[illegible]						
		[illegible]					982,000	1.964x10⁷			0.47	O
[illegible]	C(1s)	[illegible]57.2	175.7	5x10²/1	50				15 Å	1.00		
		284.6	241									
							480,000	4.8 x10⁶			0.33	C

Comments:

$$\frac{Ag}{O} \simeq \frac{1}{2}$$

elements: Ag, O, C, Ta

Figures:

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Table 3

Sample: [illegible]
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
AGFC[illegible]	Ag [illegible]											
	[illegible]	[illegible]	[illegible]	$2\times10^3/1$	20	[illegible]	293,000	2.93×10^7	15 Å	10.7	0.15	Ag
AGFC1	O(s)	532.4	246.3	$5\times10^3/5$	50	6000	367,000	7.34×10^6	14 Å	2.85	0.15	O
AGFC3	C(s)	284.8	236	$2\times10^3/1$	50	6000	320,000	1.28×10^7	15 Å	1.00	0.70	C

Comments:

$\frac{Ag}{O} = 1$

elements: Ag, O, C, Ta

Figures:

Table [illegible]

SILVER ASHED 60 SEC./CONTROL - Ag 3d 3/2 and 3d 5/2

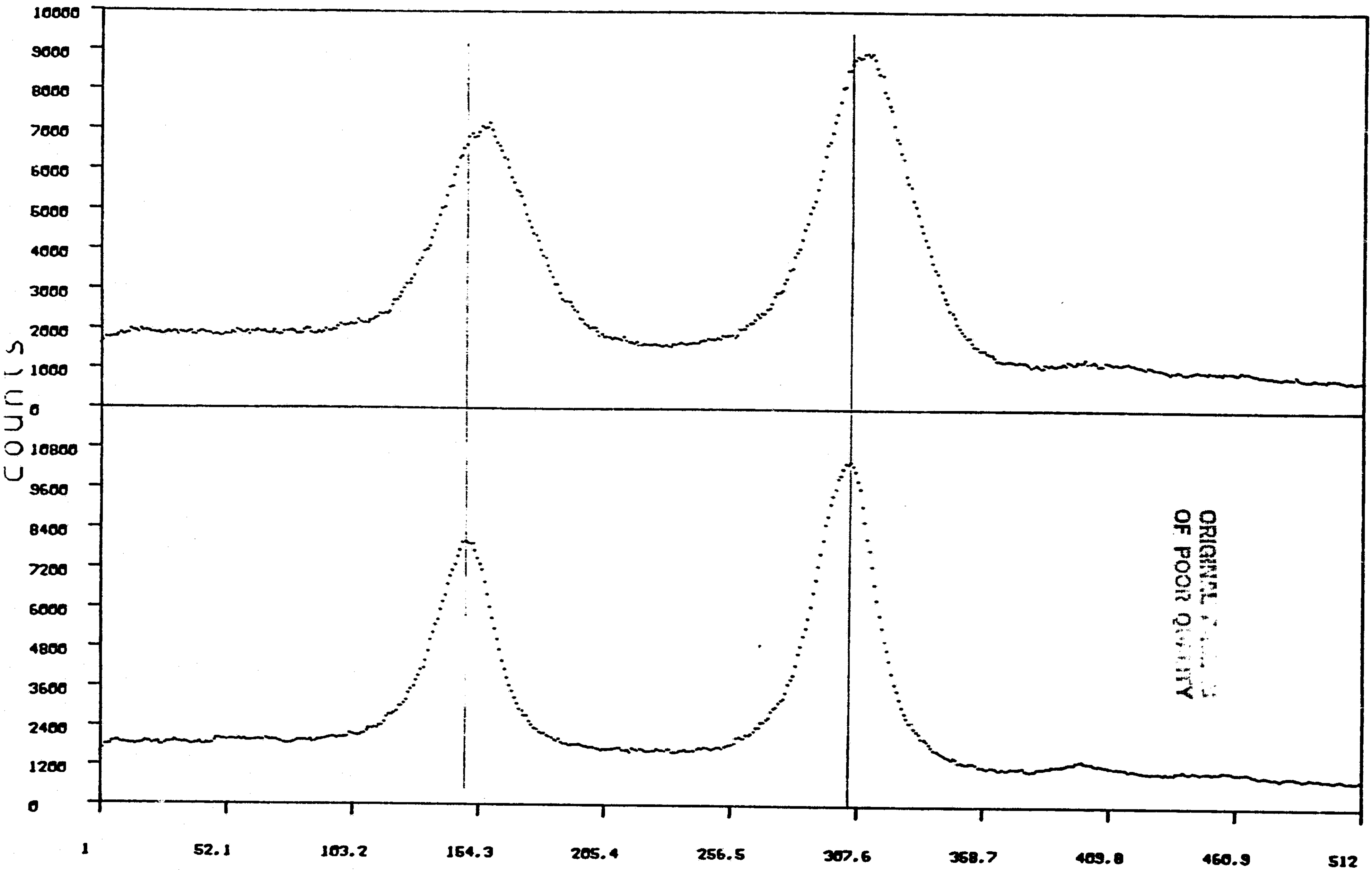
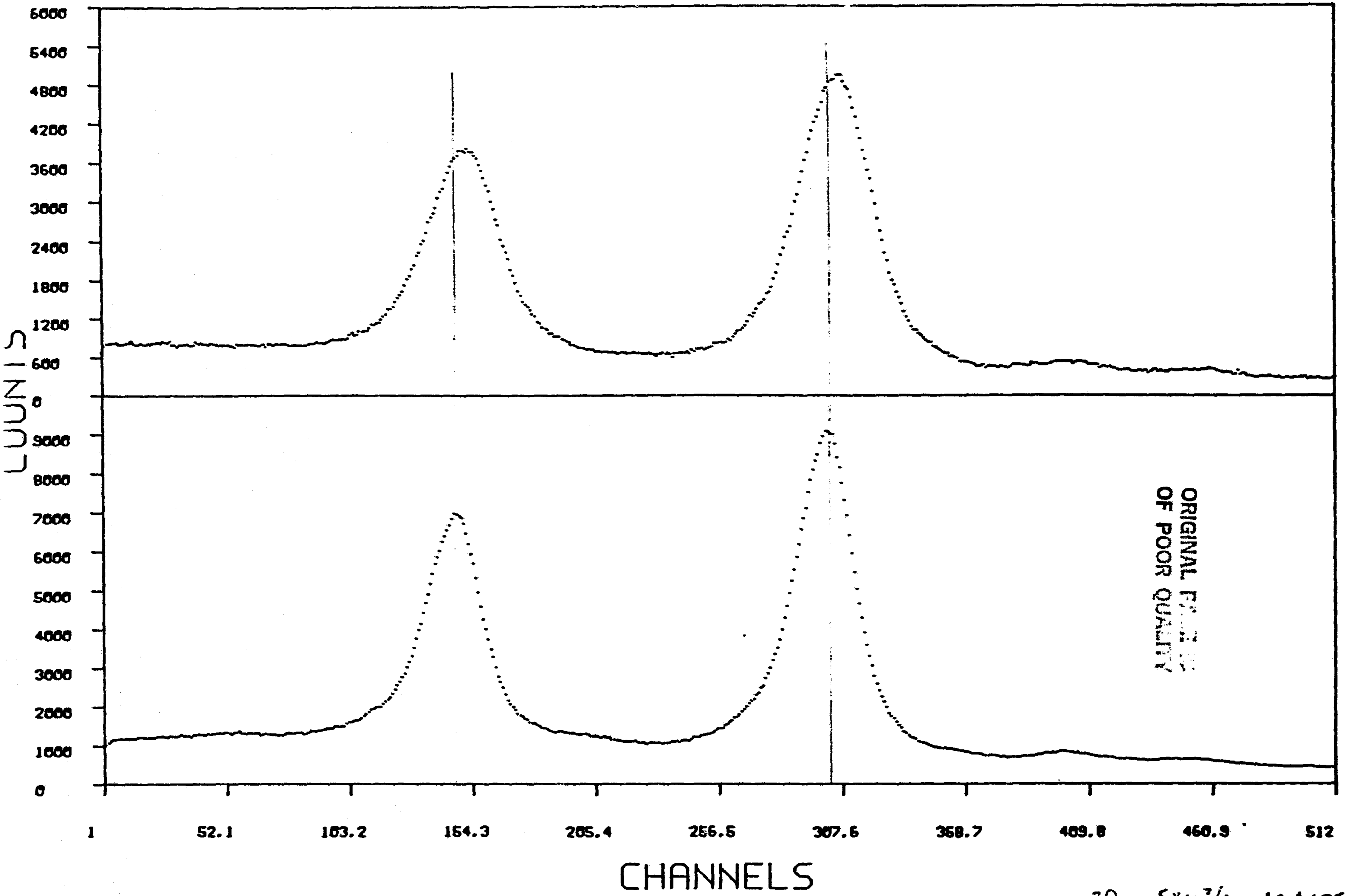


Fig 9

Ag ASHED/CONTROL (SPUTTERED) - Ag 3d 3/2 & 3d 5/2



20 5x10⁻³/1 AGA605
20 5x10⁻³/1 AGFC5

SILVER ASHED 60 SEC./CONTROL - O (1s)

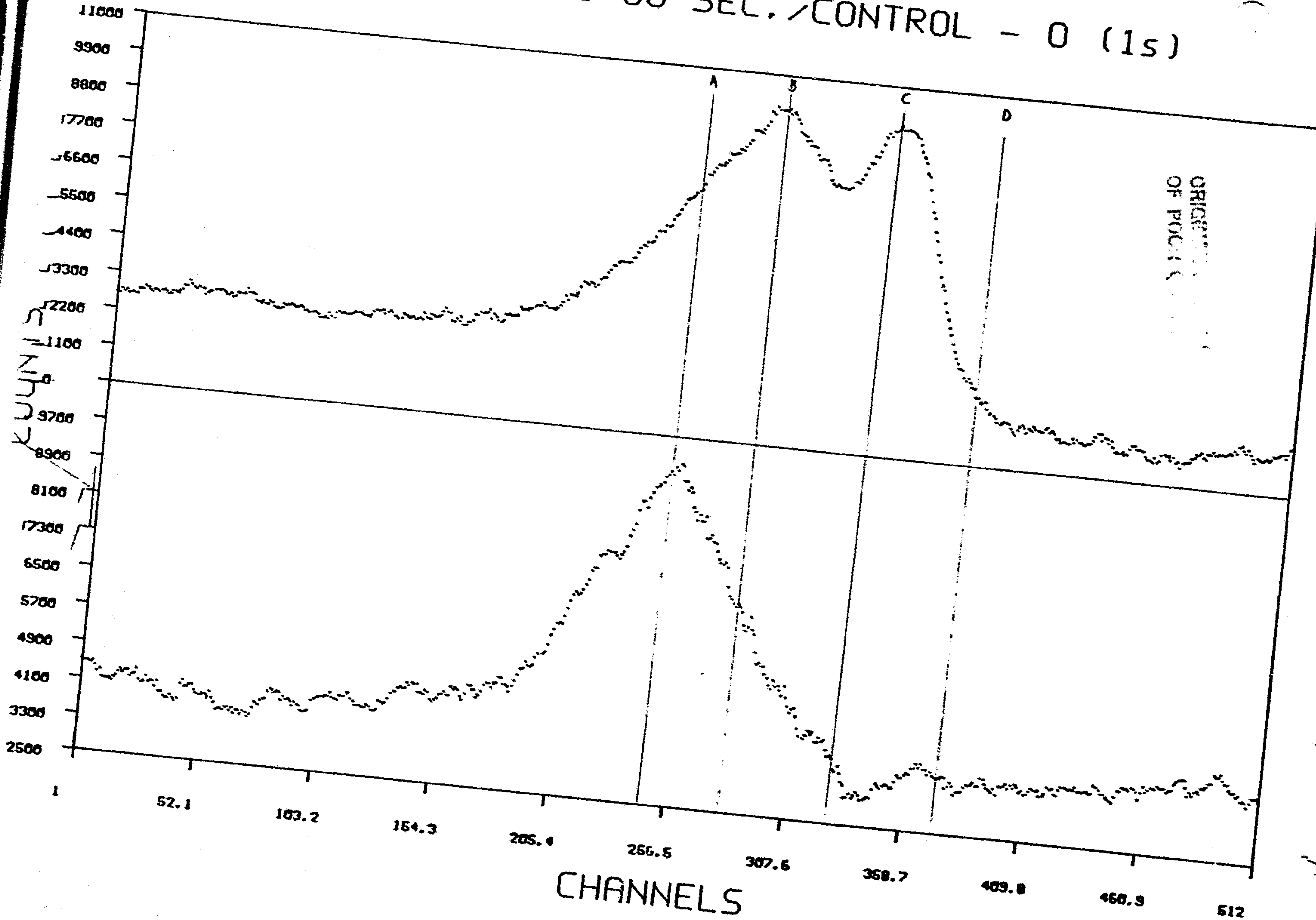


Fig 11

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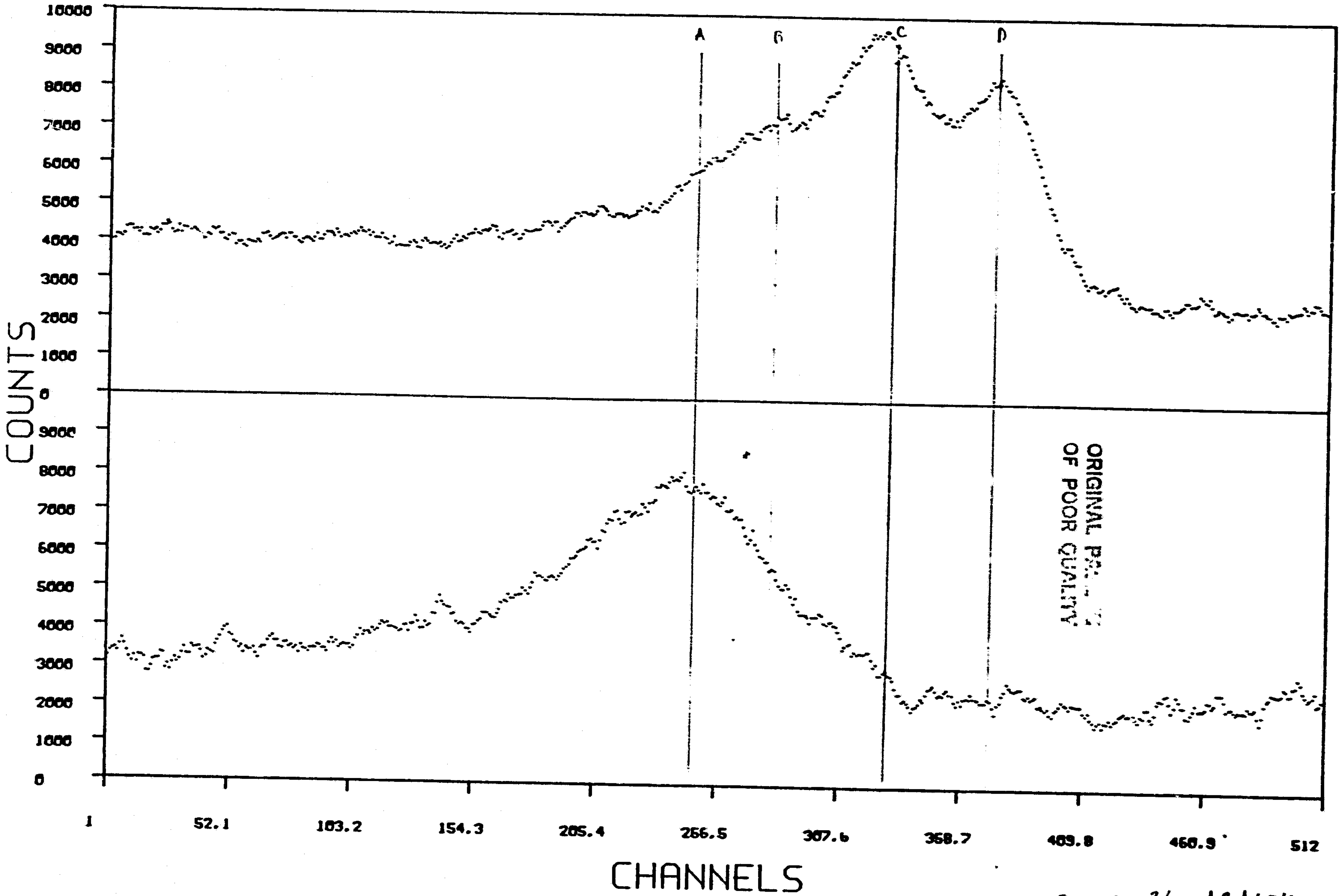
SILVER ASHED 60 S/CONTROL (SPUTTERED) - O (1s)



SD 5x10²/1 AGA604

10O 2x10⁴/20 AGFC4

Fig 12

SILVER ASHED 60 SEC./CONTROL - C (1s) peak

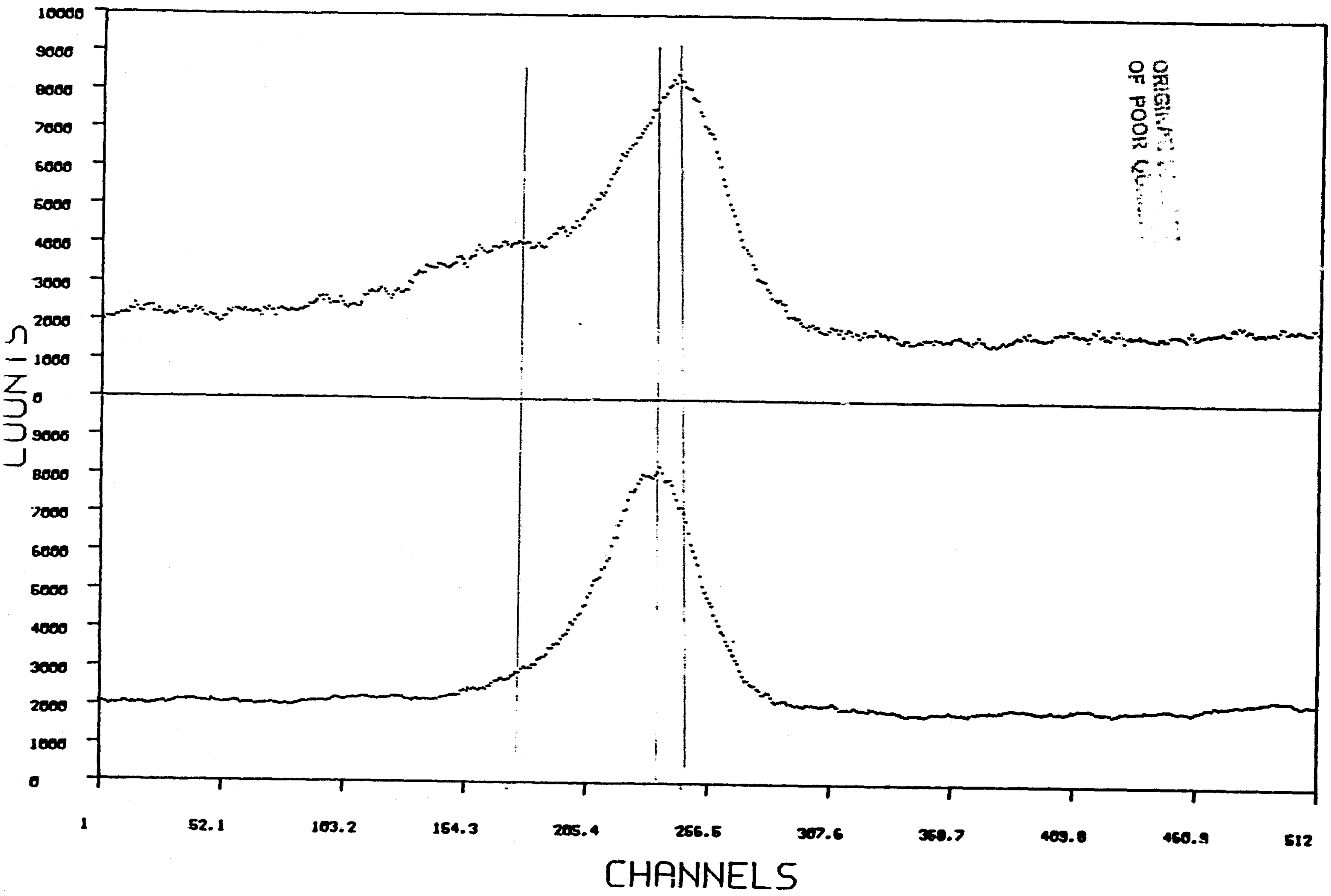


Fig 13

SILVER ASHED/CONTROL (SPUTTERED) - C 1s

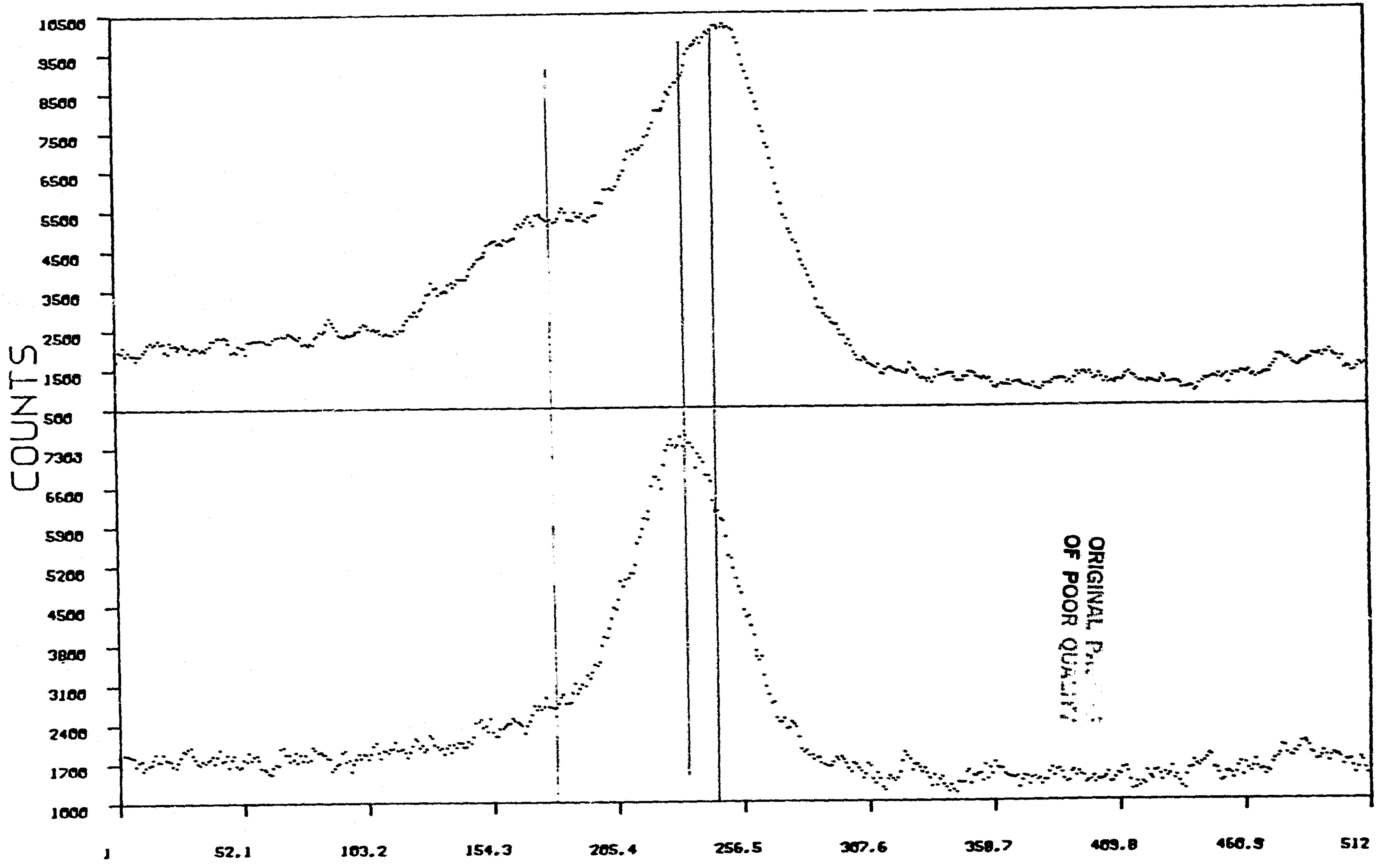


Fig 14

20 5x10⁷/₂ AGAGG

50 1x10³/₁ AGFCG

Sample: STS-8 Flight
Treatment:
Date: 8-1-84

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
STSS1	Ag 3d 3/2	374		2×10^{4}/1	50	6000						
	Ag 3d 5/2	368	308			6000	245,000	9.8×10^{7}	15 Å	10.7	0.40	Ag
STSS2	O(1s)	532.2	251	5×10^{3}/5	50	3000			14 Å	2.85		
		530.4	297			5600						
						total	472,000	9.44×10^{6}			0.16	O
STSS3	C(1s)	286.9	[illegible].45	5×10^{3}/5	50	800			15 Å	1.00		
		284.3	249			7500						
						total	506,000	1.012×10^{7}			0.44	C

Comments:

elements: Ag, Cu, Cl, S, Ta

Figures:

Table 5

Sample: STS-8 Control
Treatment:
Date: 8-1-84

scan	peak	B.E. (eV)	ch. #	inten.	E_o (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
STSC1	Ag 3d5/2	374		$1\times10^4/1$	50							
	Ag 3d3/2	368	308				273,000	5.46×10^7	15 Å	10.7	0.19	Ag
STSC2	O(1s)	532.2	251	$5\times10^3/5$	50		726,000	1.454×10^7	14 Å	2.85	0.20	O
STSC3	C(1s)	286.7	188.7	$5\times10^3/2$	50	1500			15 Å	1.00		
		284.7	238.7			6500						
						total	332,000	1.66×10^7			0.61	C

Comments:
A[illegible] 1 ⇒ Ag[illegible]

elements: Ag, O, C, Cl, S, Ta

Figures:

Table 6

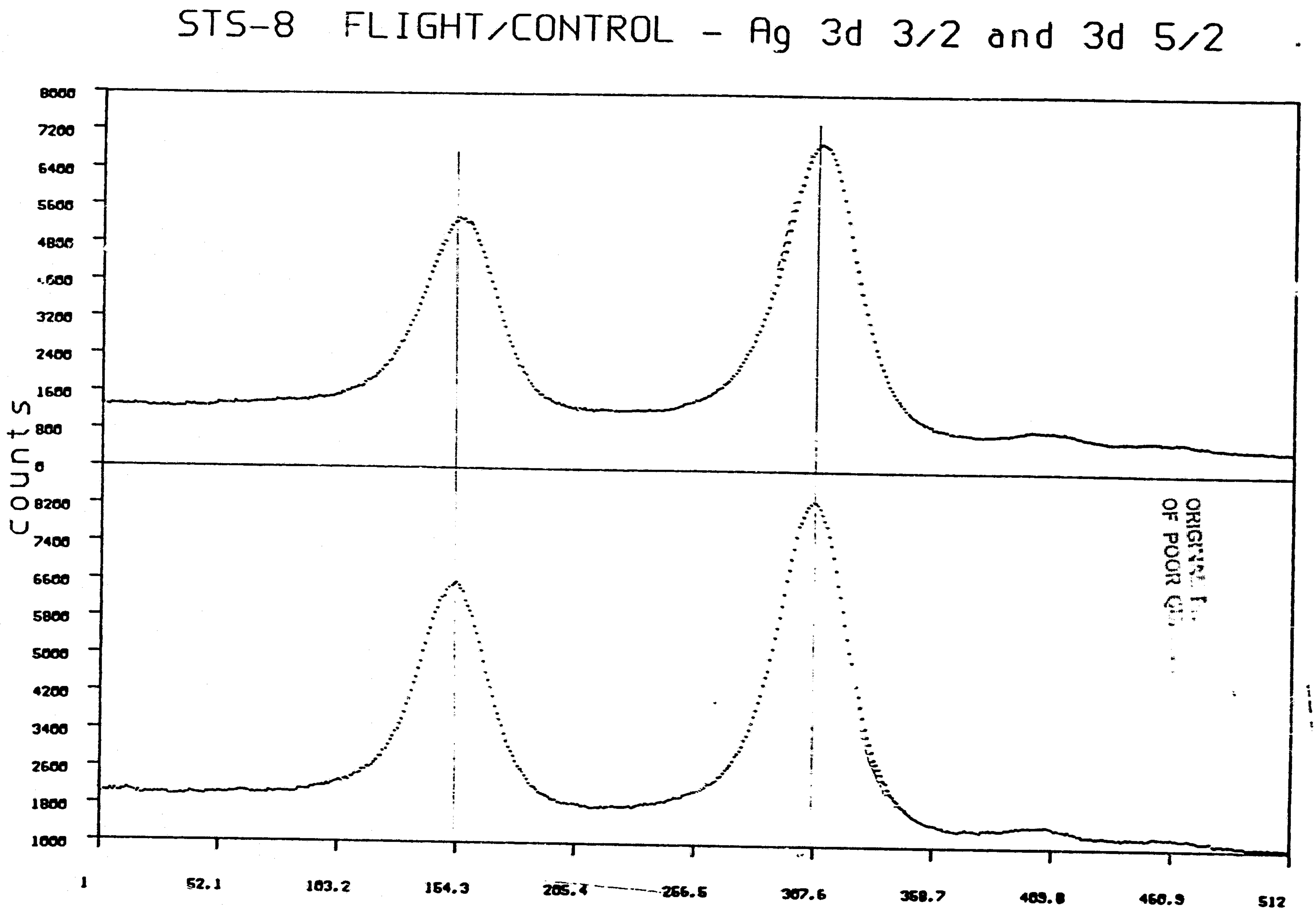

STS-8 FLIGHT/CONTROL - Ag 3d 3/2 and 3d 5/2
counts
8000
7200
6400
5600
4800
3200
2400
1600
800
0
8200
7400
6600
5800
5000
4200
3400
2600
1800
1000
1
52.1
103.2
154.3
205.4
256.5
307.6
358.7
409.8
460.9
512
channels
ORIGINAL
OF POOR

Fig 15

STS-8 FLIGHT/CONTROL SPUT. - Ag 3d 3/2 and 3d 5/2.

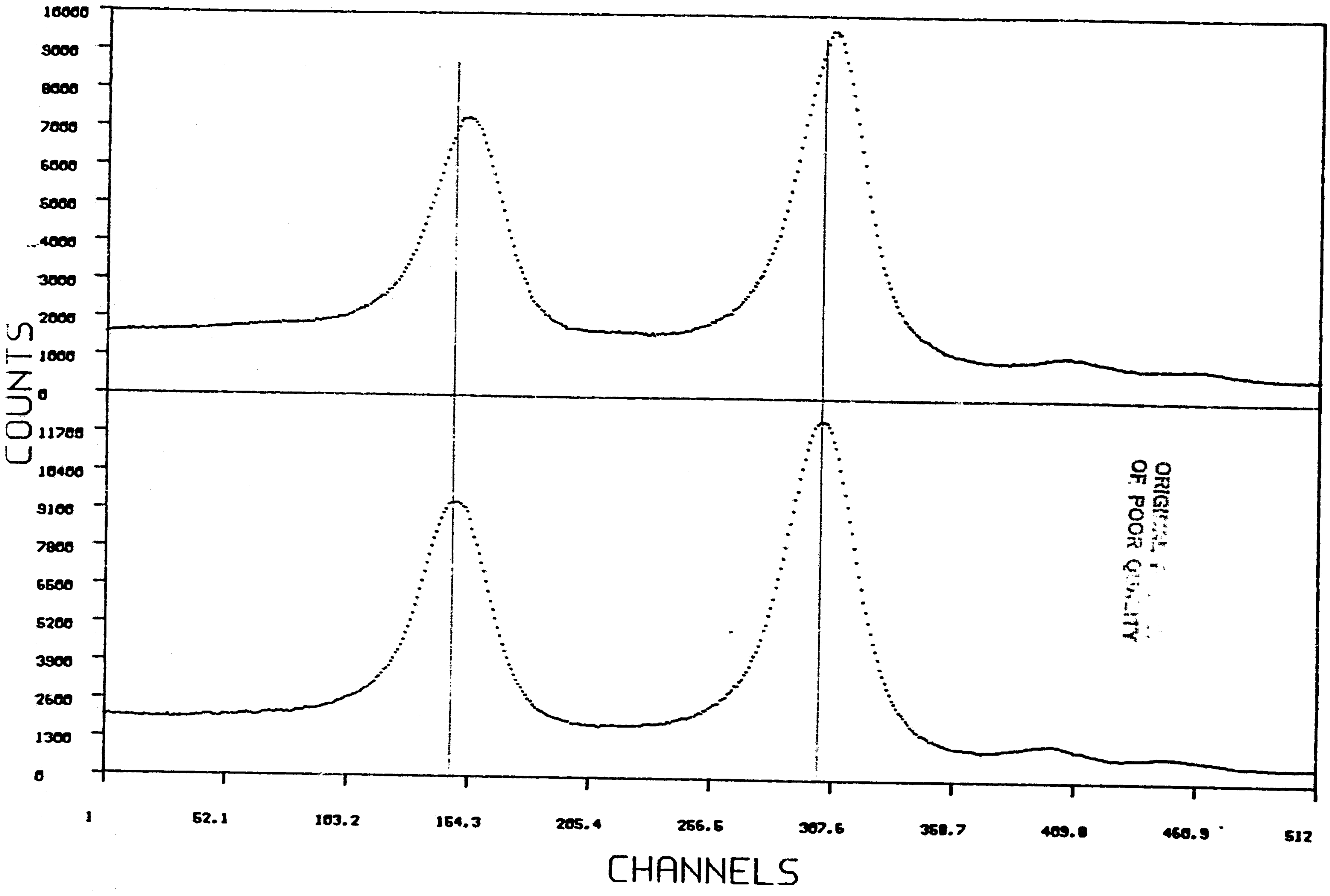


Fig 1c

STS-8 FLIGHT/CONTROL - O 1s

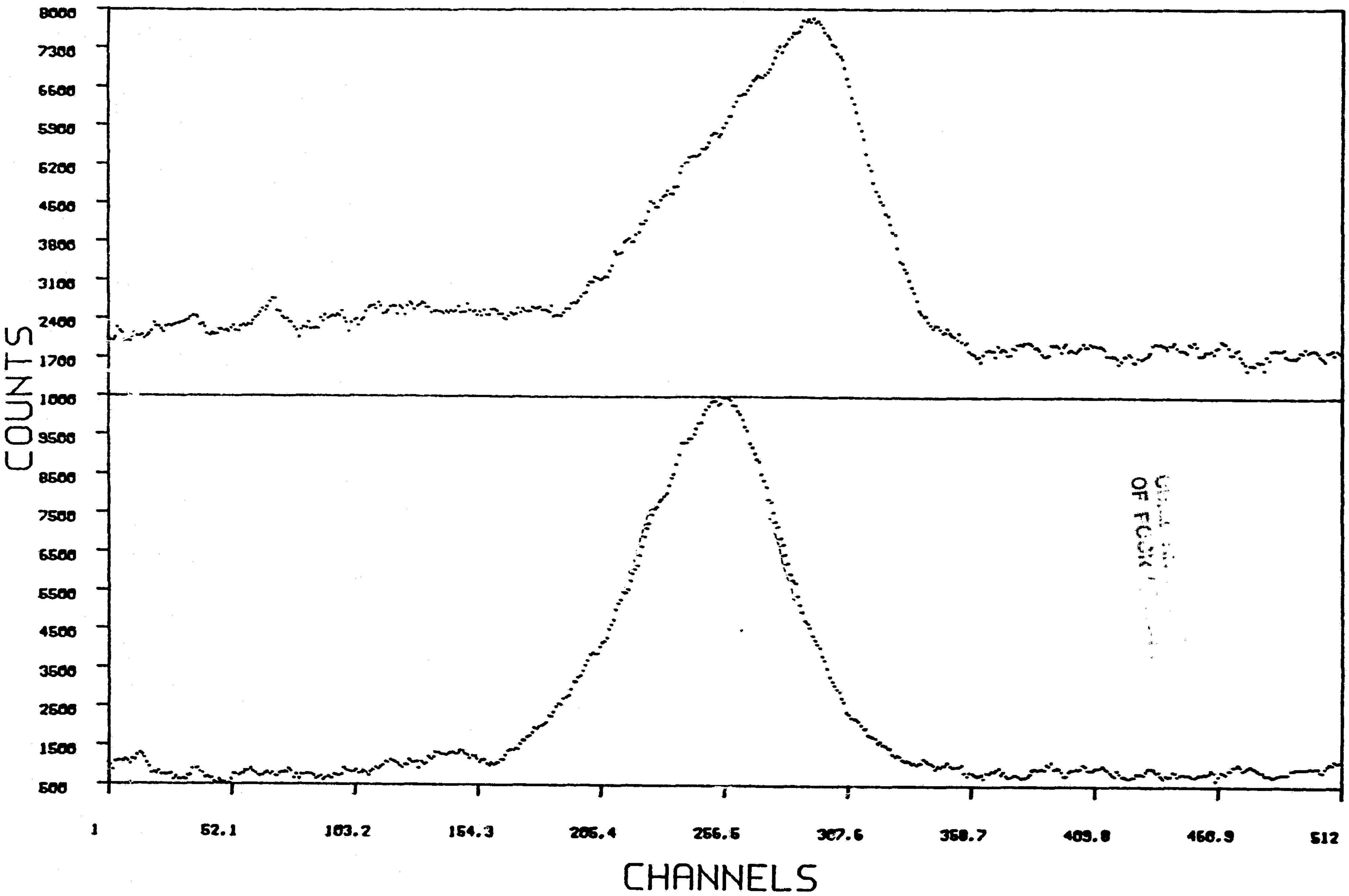


Fig 17

STS-8 FLIGHT/CONTROL (SPUTTERED) - O 1s

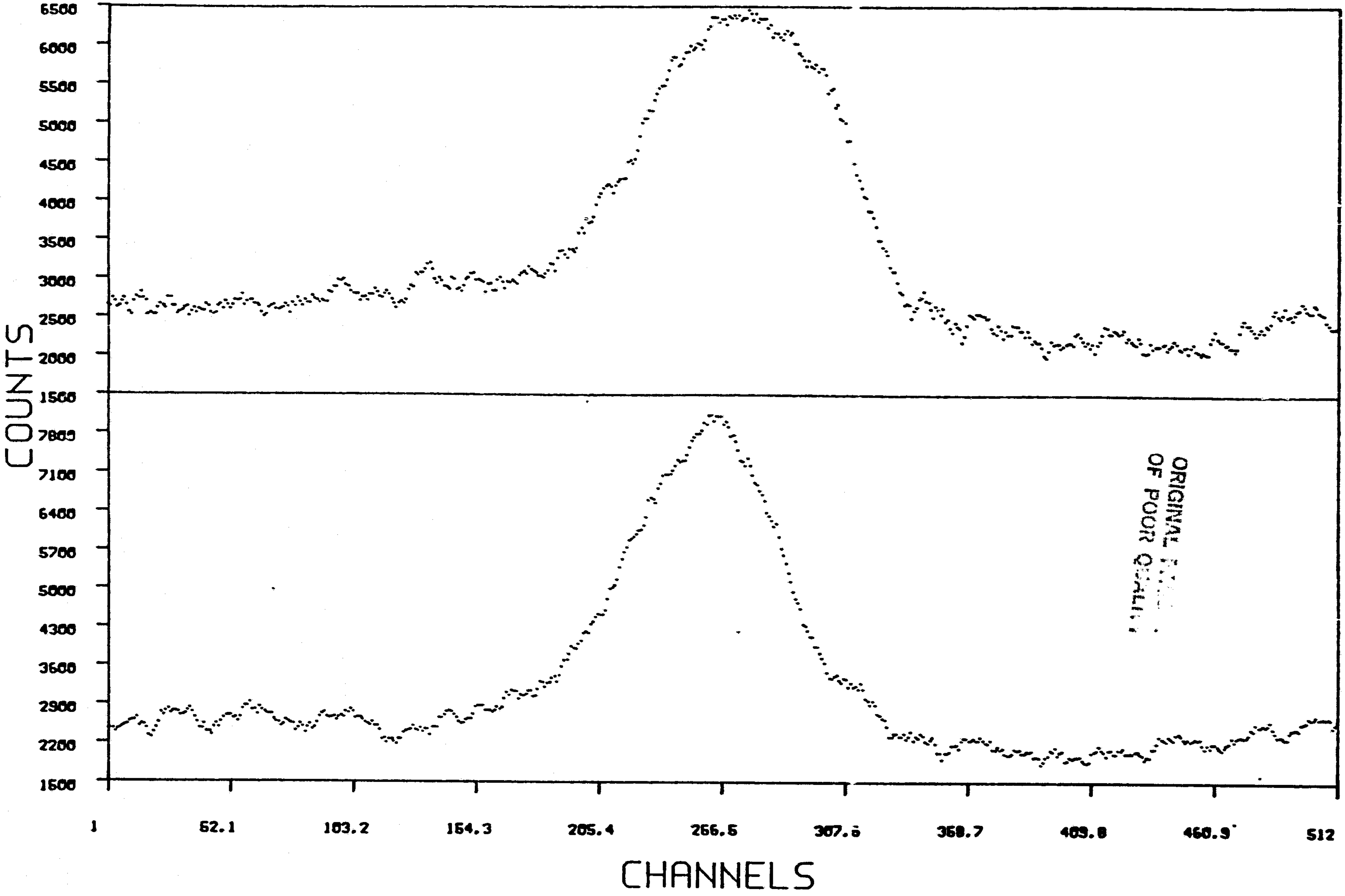


Fig 8

STS-8 FLIGHT/CONTROL - C 1s

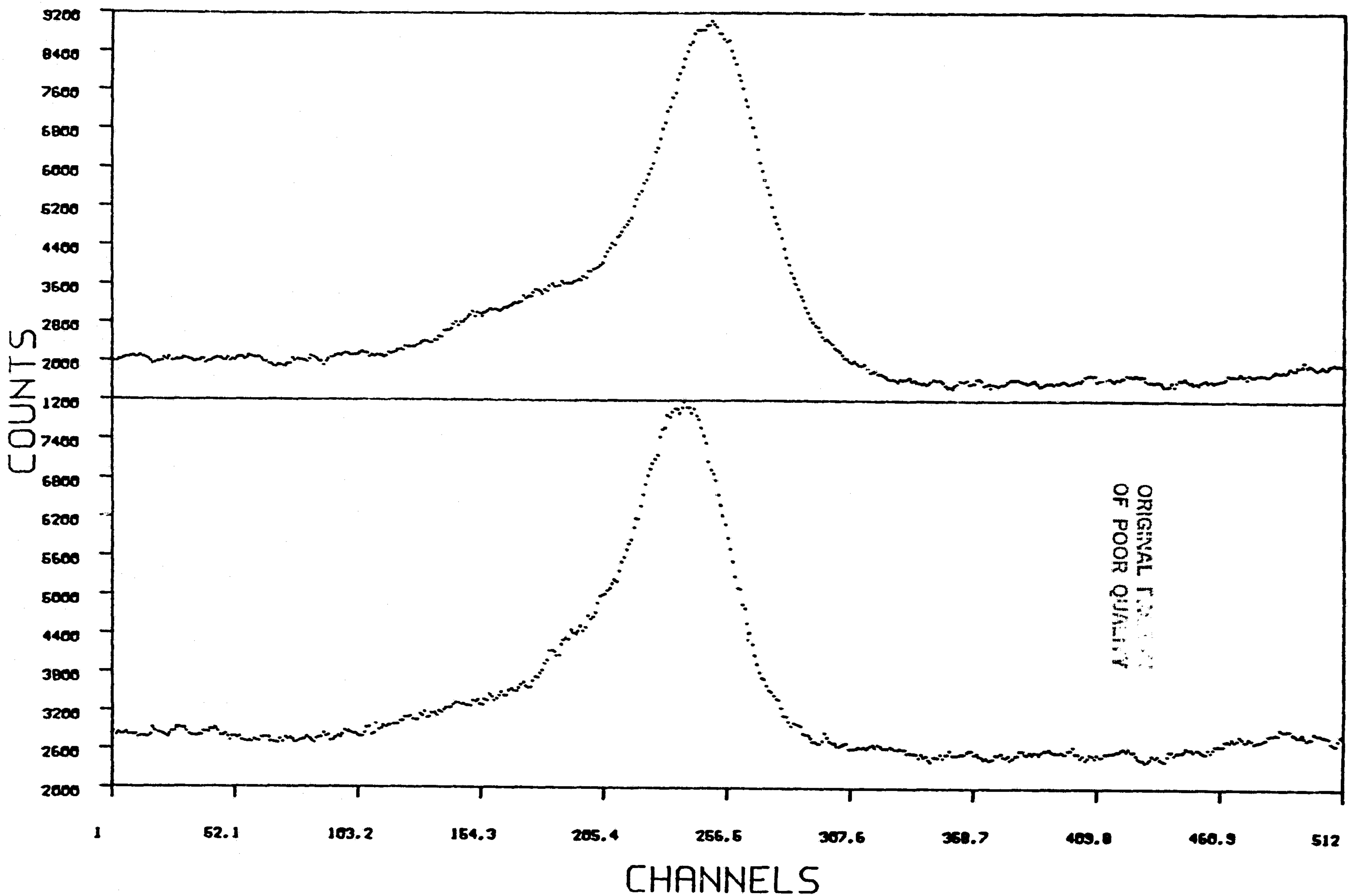


Fig 19

STS-8 FLIGHT/CONTROL (SPUTTERED) - C 1s

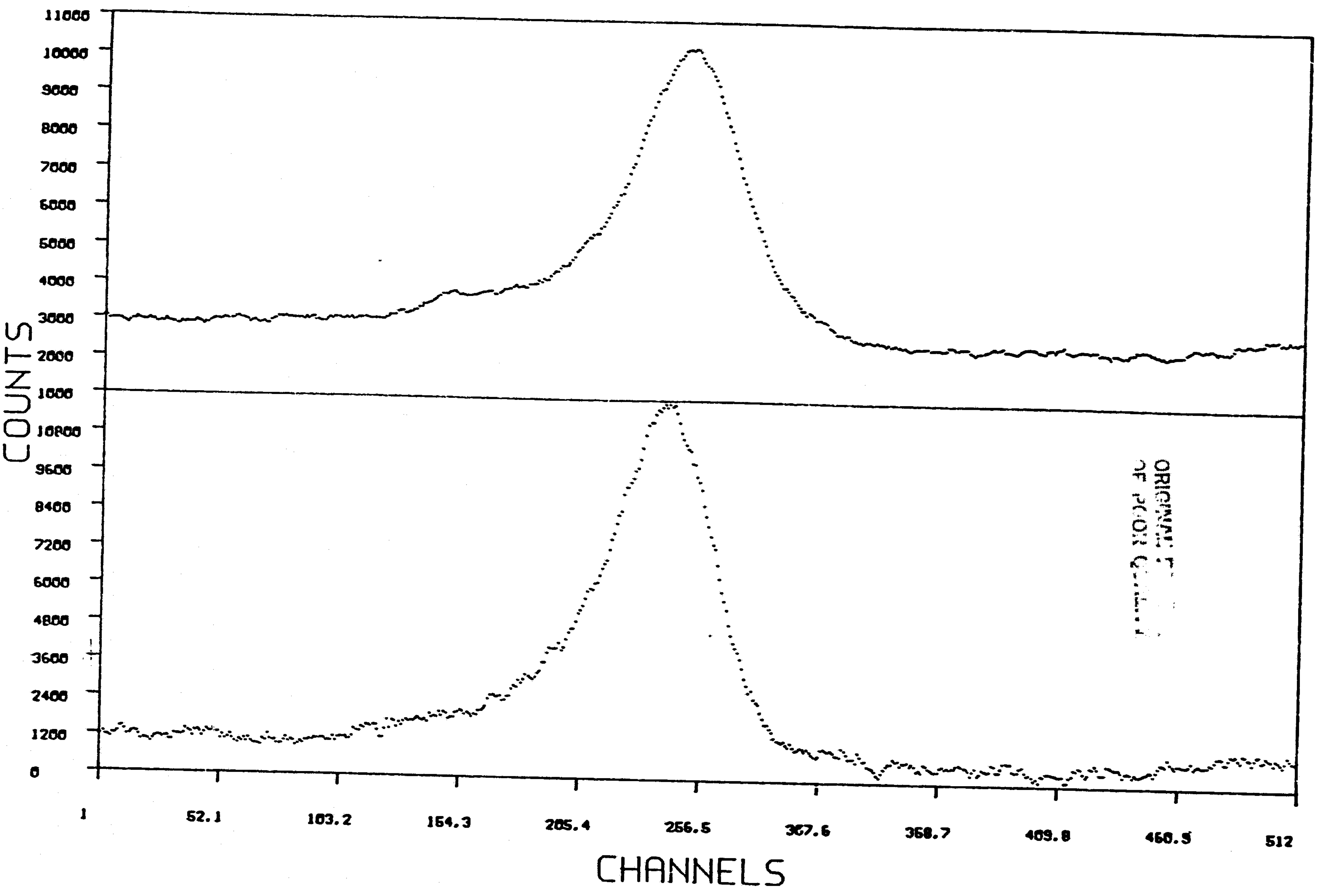


Fig 20

50 5×10^3/s STS86
50 5×10^3/s STS

Sample: Silver [illegible] /Flight
Treatment:
Date: 7 [illegible] 84

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
AG 3	Ag $3d_{3/2}$			$1\times10^4/1$	50							
	Ag $3d_{5/2}$	367.9	312.7				233,000	4.66×10^7	15 Å	10.7	0.22	Ag
AG 5	O(1s)	532.2	251.4	$5\times10^2/2$	20	4000			14 Å	2.85		
		530.4	297.4			4000						
						total	632,000	7.9×10^6			0.15	O
AG 4	C(1s)	285.7	213.1	$5\times10^3/5$	50	1000			15 Å	1.00		
		284.35	247.6			7000						
						total	613,000	1.226×10^7			0.63	C

Comments:

Elements: Ag, O, C, Ta,

Figures:

ORIGINAL [illegible]
OF POOR [illegible]

Table 7

Sample: Silver /Control
Treatment:
Date: 7-27-84

scan	peak	B.E. (eV)	ch. #	inten.	E_o (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
AGBL2	Ag 3d5/2			$1\times10^{?}/1$	50							
	Ag 3d5/2	368.1	305			2000	97,500	1.45×10^{7}	15 Å	10.7	0.16	Ag
AGBLS	O(1S)	532.2	251.4	$5\times10^{2}/2$	20	3000			14 Å	2.85		
		530.4	297.4			2000						
						total	386,000	4.925×10^{6}				
AGBL4	C(1S)	285.4	220.1	$5\times10^{3}/5$	50				15 Å	1.00	0.16	O
		284.4	246.3									
		282.8	287.2									
						total	399,000	7.98×10^{6}			0.68	C

Comments:
[illegible] : 1 => AgO

[illegible] : Ag, [illegible], Ta, Cl

Figures:

Table 8

SILVER FLIGHT/CONTROL - Ag 3d 3/2 and 3d 5/2 peaks

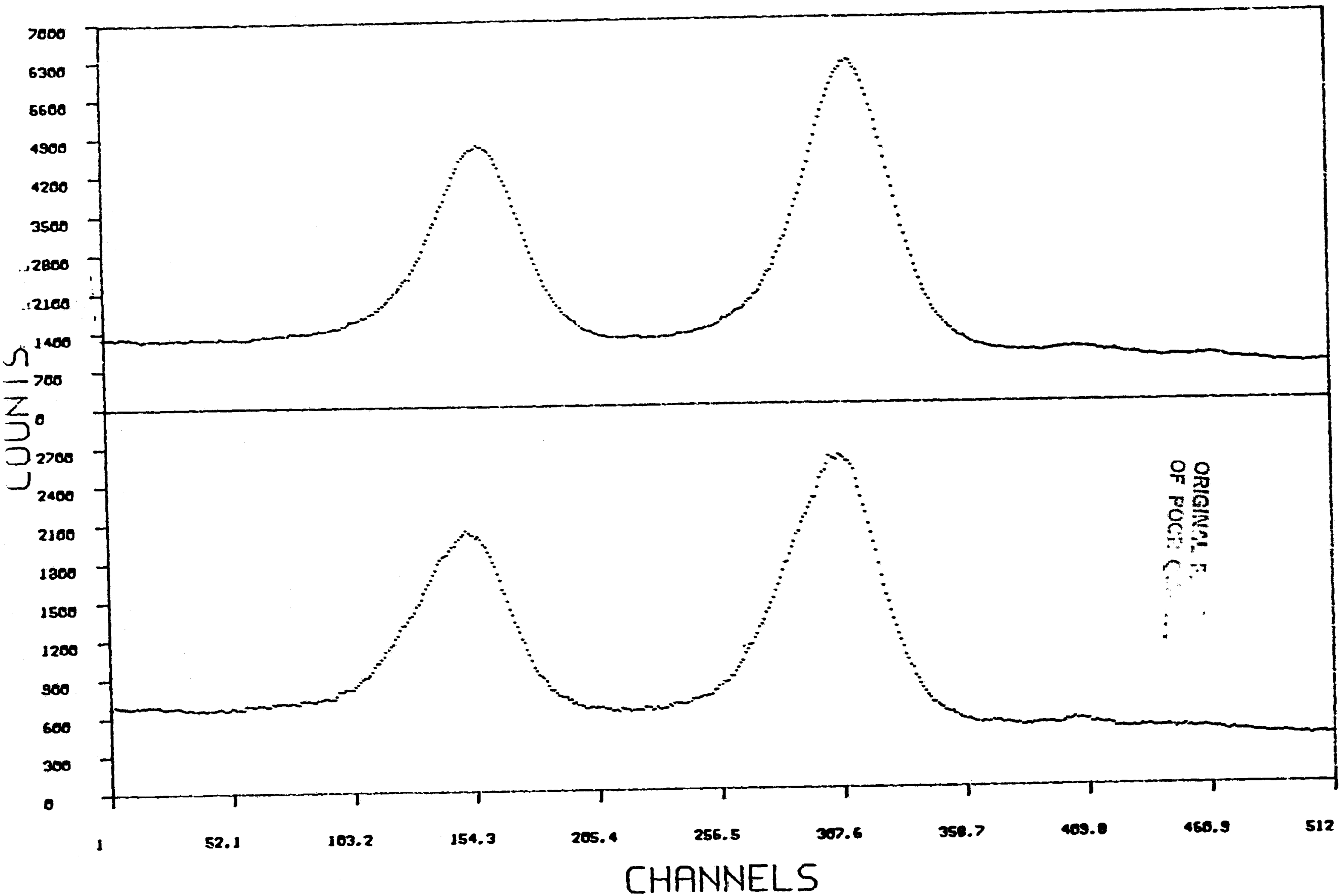


Fig 31

Ag FLIGHT/CONTROL (SPUTTERED) - Ag 3d 3/2 and 3d 5/2

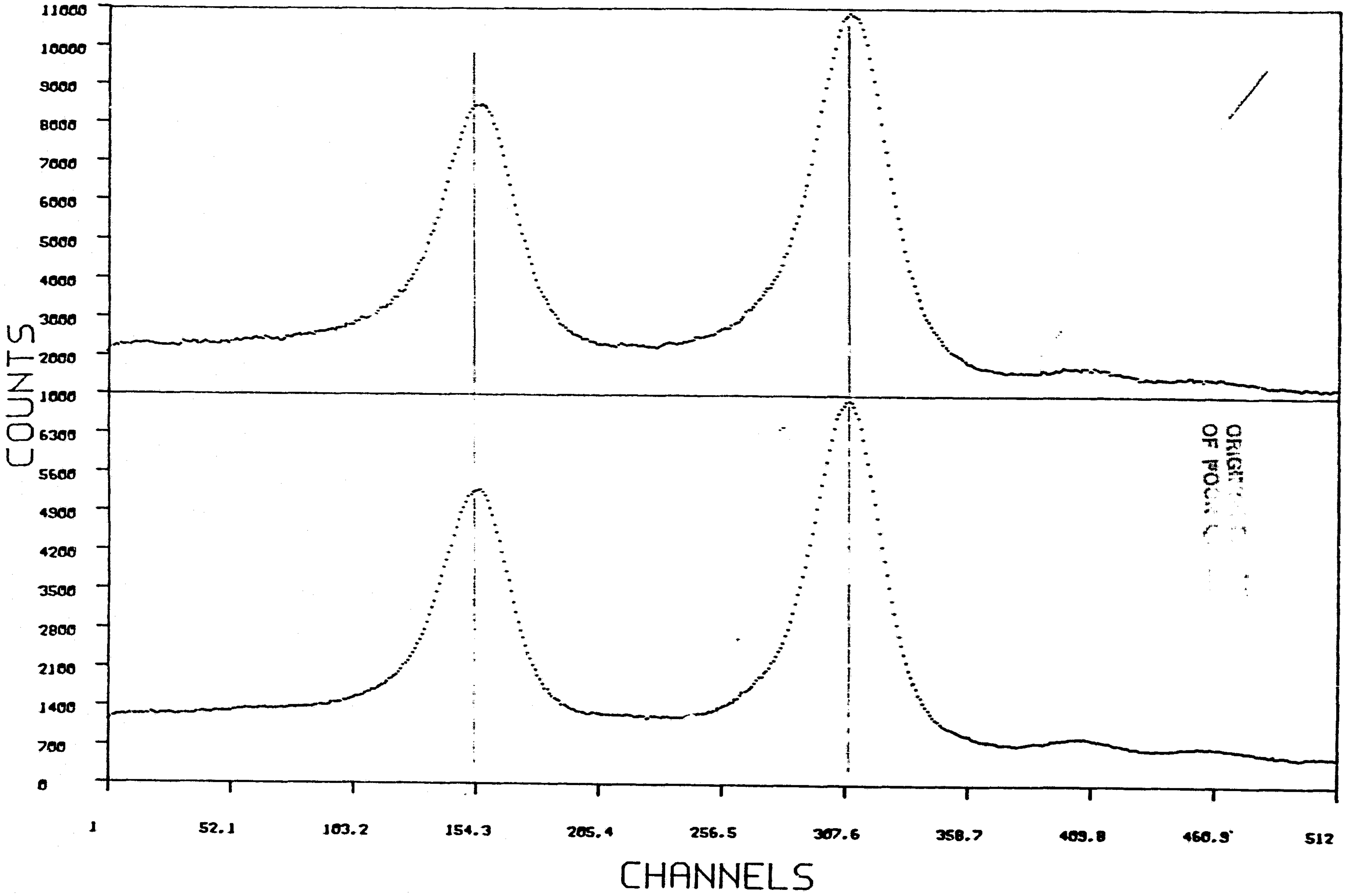


Fig 22

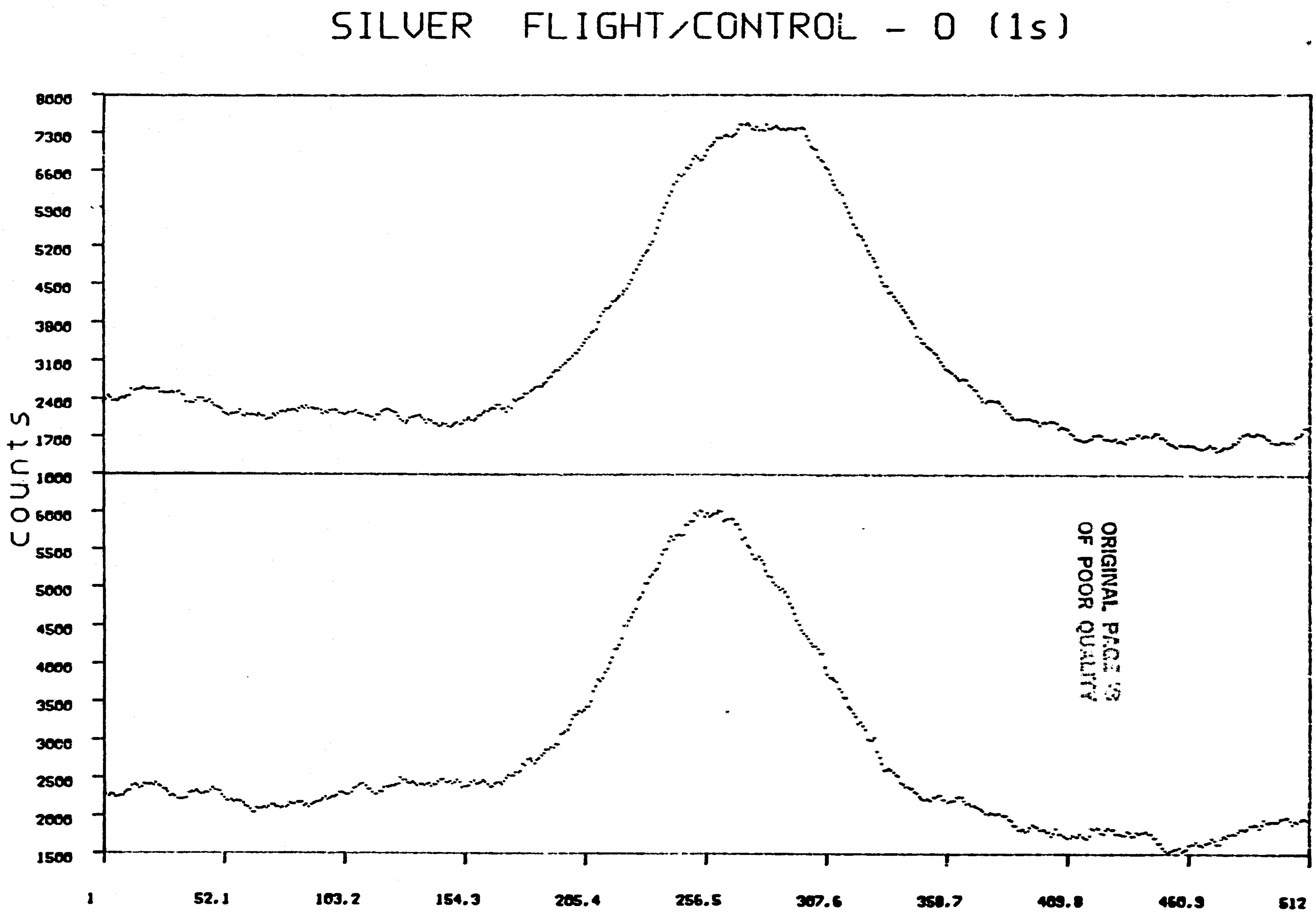

SILVER FLIGHT/CONTROL - O (1s)
counts
8000
7300
6600
5900
5200
4500
3800
3100
2400
1700
1000
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1
52.1
103.2
154.3
205.4
256.5
307.6
358.7
409.8
460.9
512
channels
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Fig 23

SILVER FLIGHT/CONTROL (SPUTTERED) - O 1s

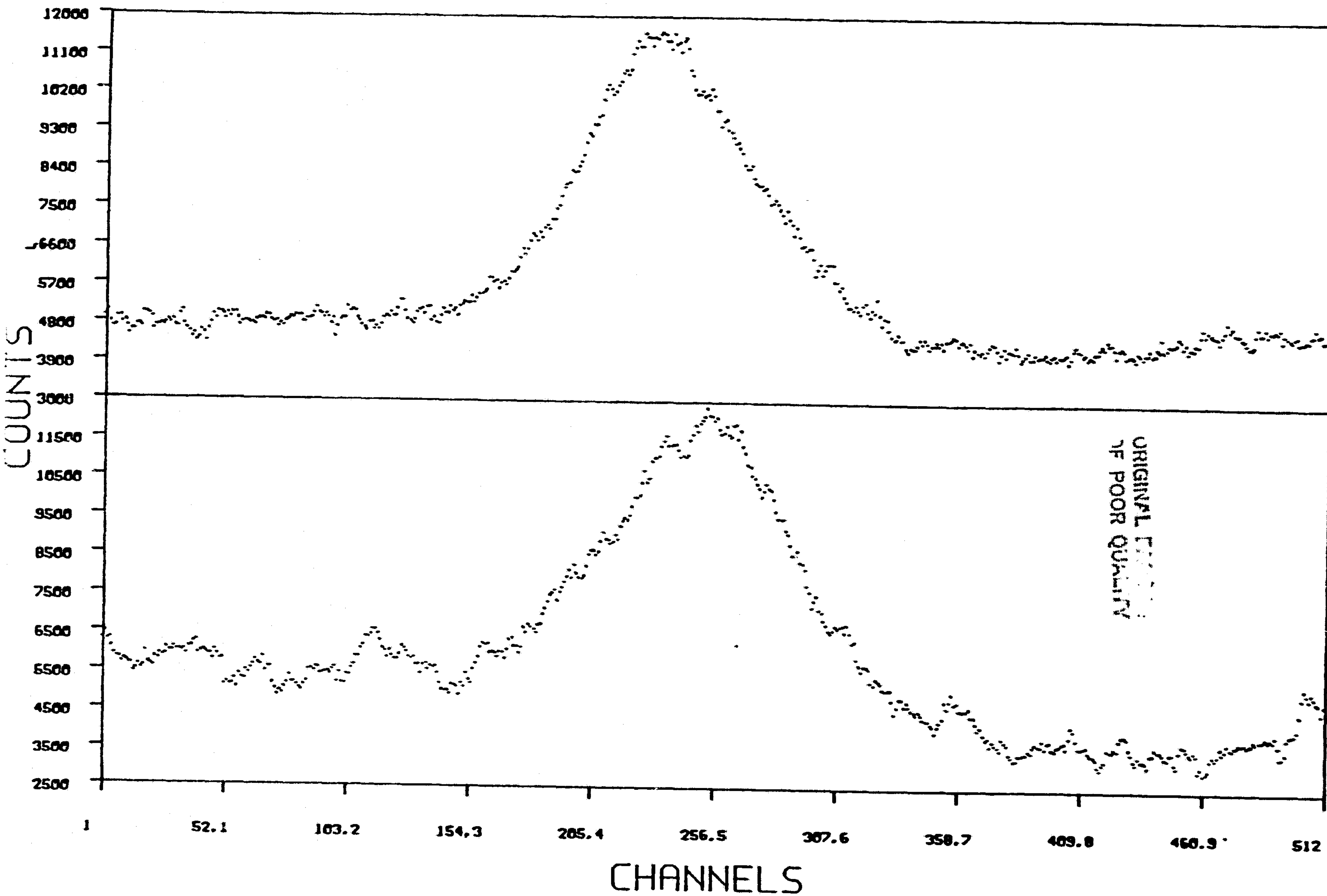


Fig 24

SO 1x10³/1 AG10

SILVER FLIGHT/CONTROL - C (1s) peak

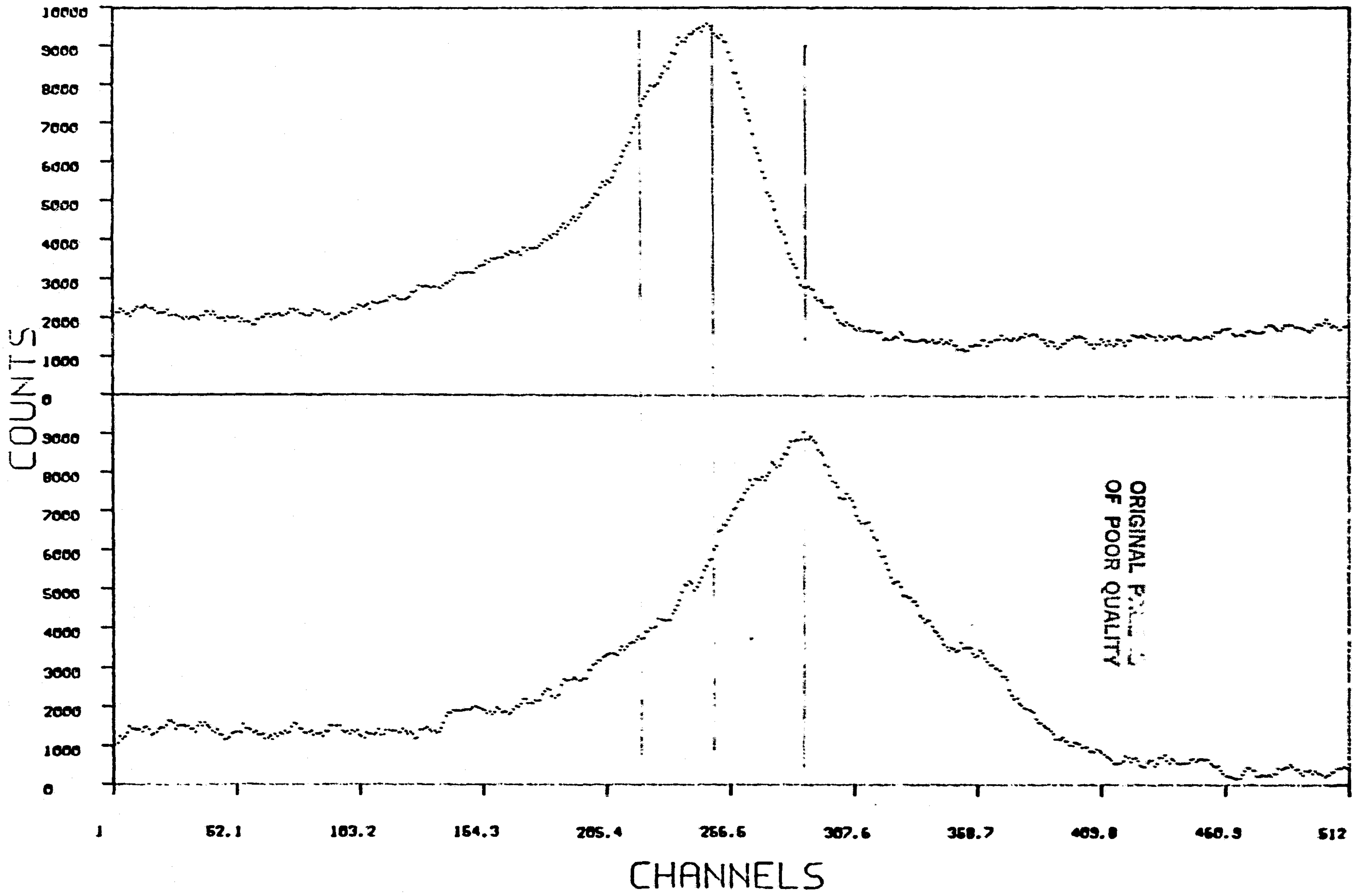
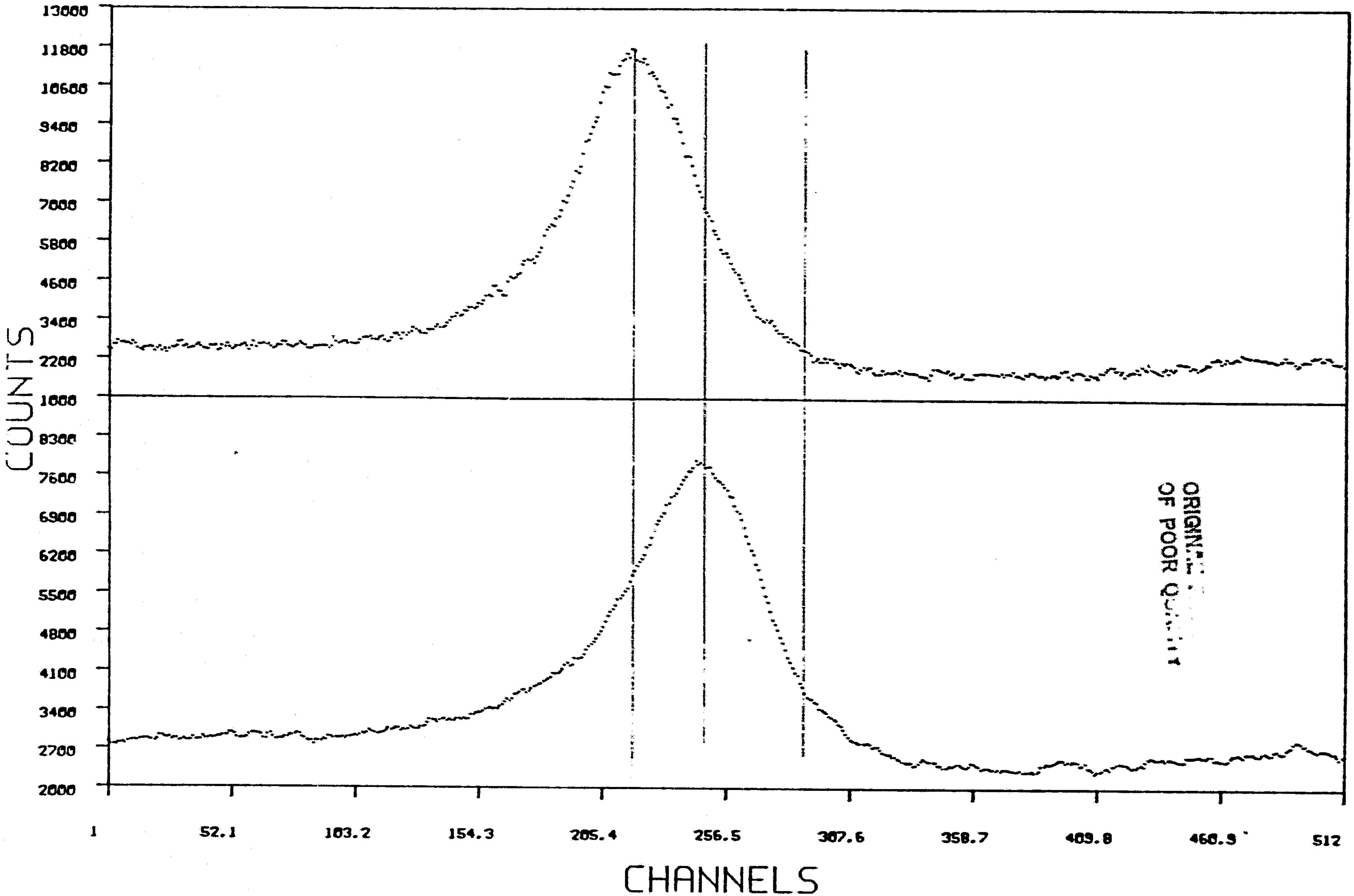


Fig 25

SILVER FLIGHT/CONTROL (SPUTTERED) - C (1s) peak.



Sample: Copper /Flight
Treatment:
Date: 7-19-84

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
CU4	Cu $2p_{1/2}$			$5\times10^4/5$	100		1,072,000	1.072×10^8	10	8.18		
	Cu $2p_{3/2}$									15.9		
										24.08	0.17	Cu
CU 6	O(1s)			$5\times10^3/t$	50		1,009,000	2.019×10	14	2.55		
											0.19	O
CU 2	C(1s)			$5\times10^3/1$	100	NSA (×3)			15	1.00		
							169,000	2.535×10^7			0.64	C

Comments:
$\frac{Cu}{O} \sim 1 \overset{?}{\Rightarrow} CuO$

Figures:

Table

Sample: Copper Control
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
CUBL2	Cu $2p\frac{1}{2}$	953.6		$5\times10^4/5$	100				10	8.18		
		952.2										
	Cu $2p\frac{3}{2}$	933.6								15.9		
		932.4										
						total	835,000	8.35×10^7		24.08	0.083	Cu
CUBL3	O (K)			$1\times10^4/1$	100		717,000	7.17×10^7	14	2.85		
											0.43	O
CUBL4	C (K)			$5\times10^3/1$	100				15	1.00		
						total	615,000	3.075×10^7			0.49	C

Comments:

Figures:

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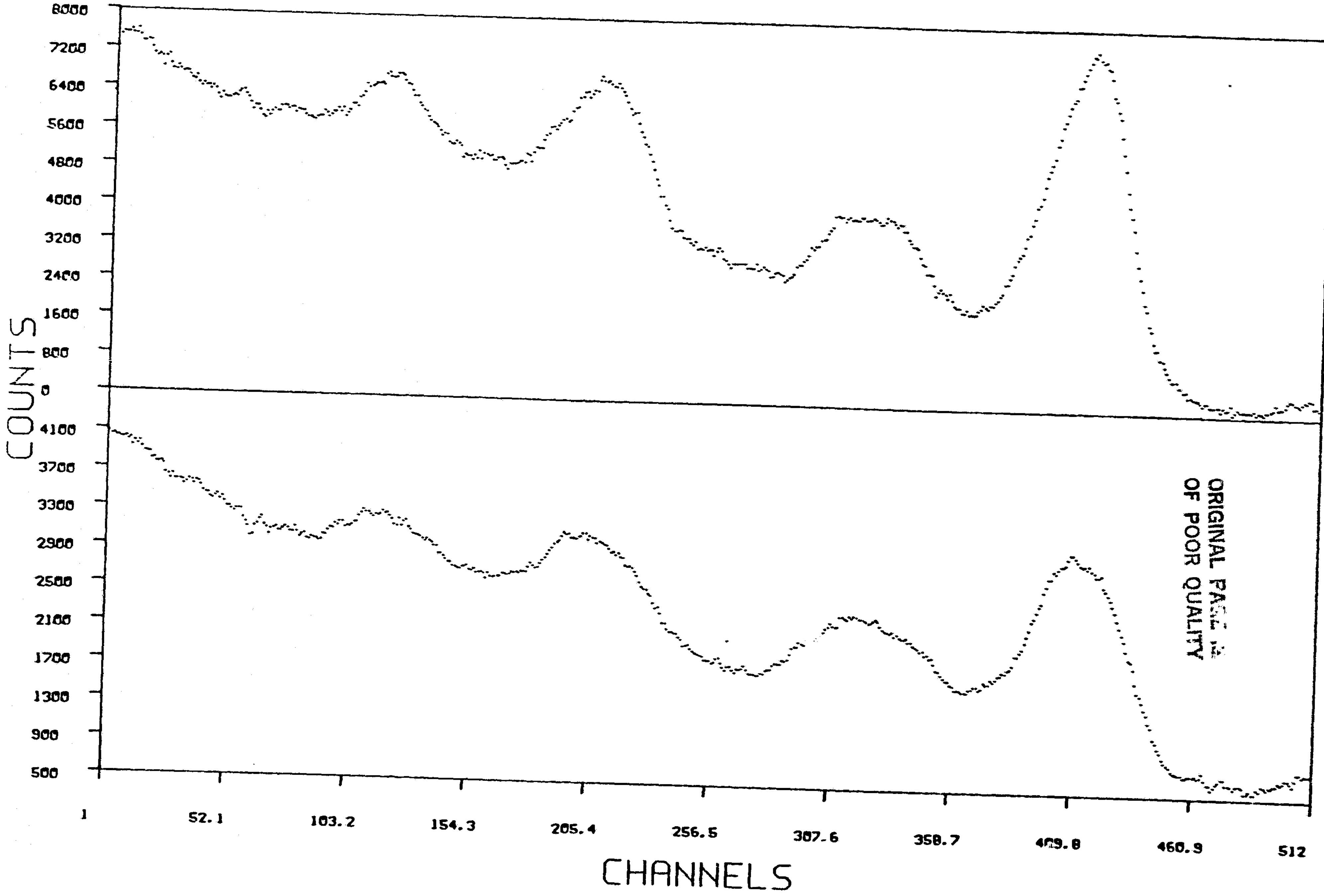
Table 8

COPPER FLIGHT/CONTROL - Cu 2p 1/2 and 2p 3/2



100 5x10^4/5 CU4
CUBLI

COPPER FLIGHT/CONTROL - O 1s

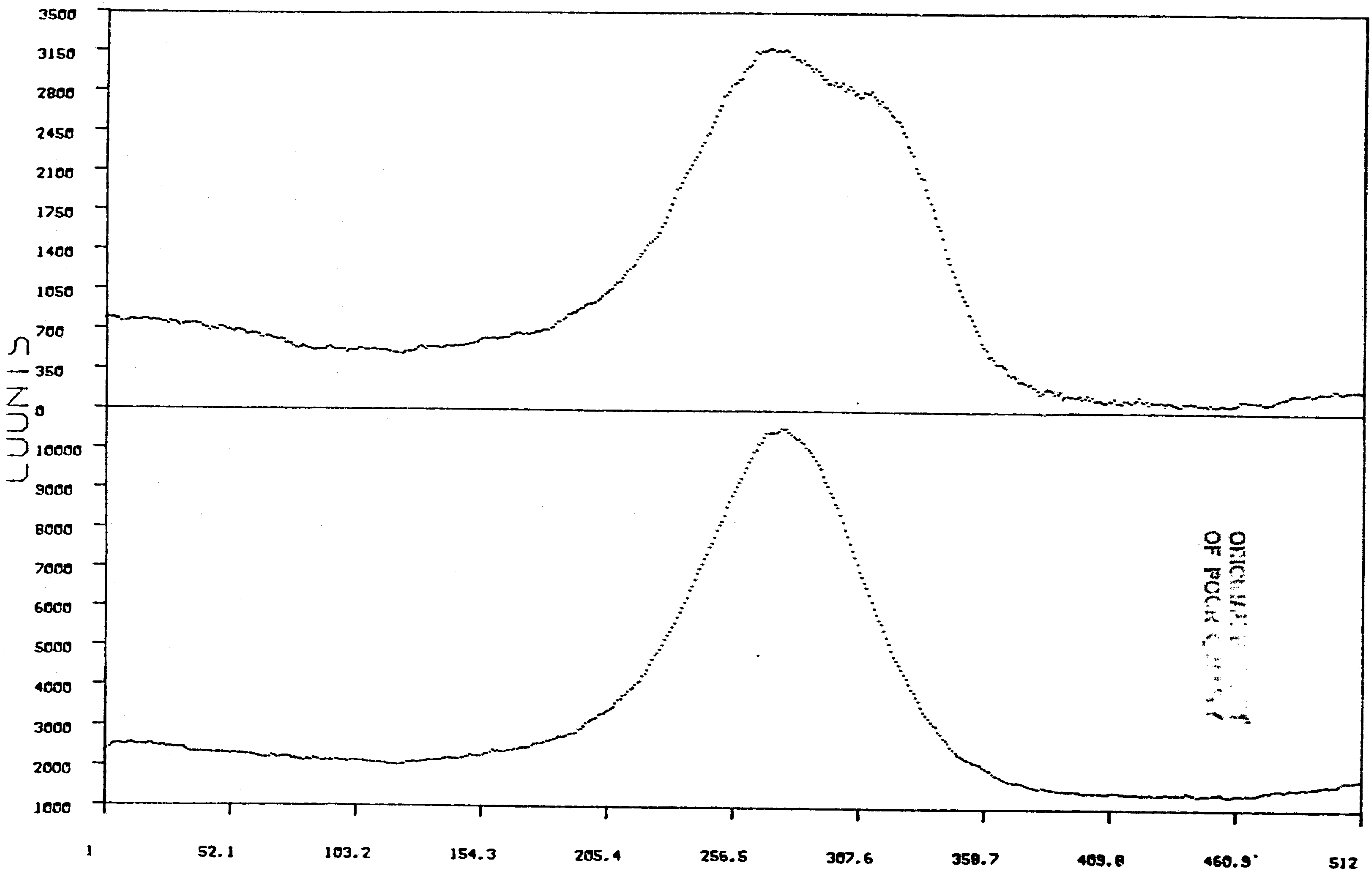


Fig 28

50 5X10 %/5 CU3

CUBL3

COPPER FLIGHT/CONTROL - C 1s

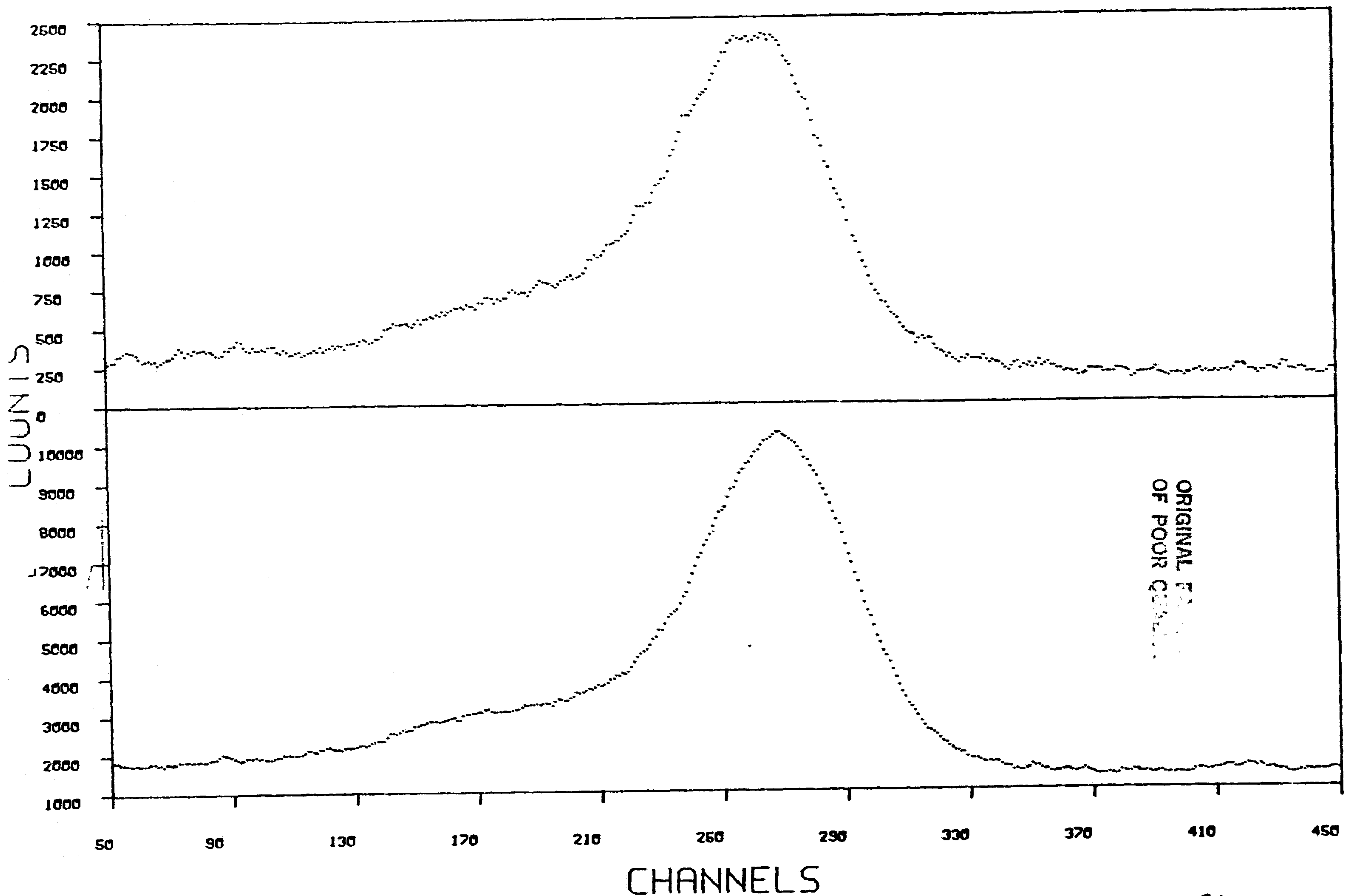


Fig 29

CU2
CUBL4

Cu FLIGHT SAMPLE - Angle Resolved O 1s Peaks

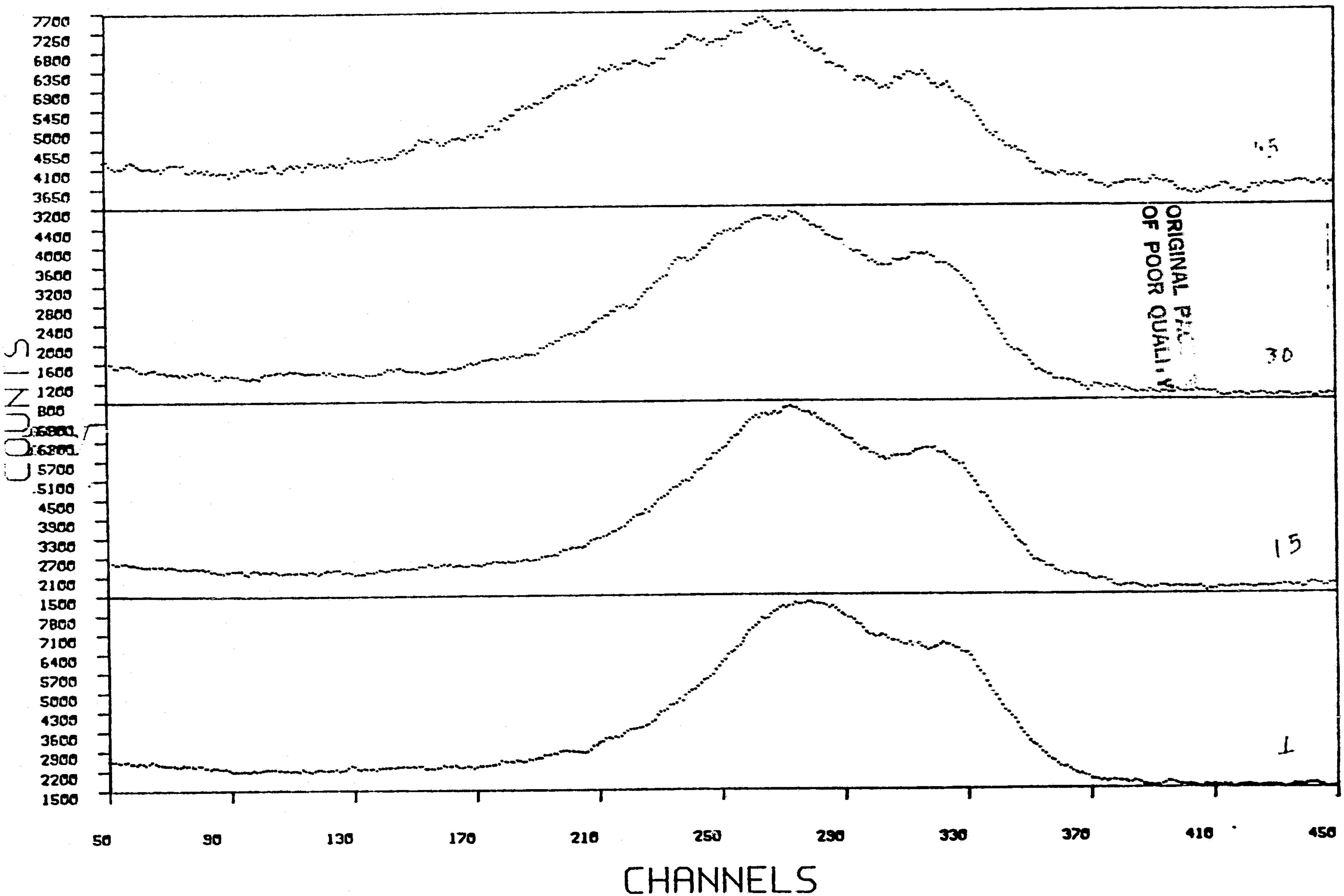


Fig 30

Sample: A-276 Flight
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
A276A	Si(2p)	109.3		$5\times10^2/1$	50		1152	11,520	15 Å	0.865	0.18	
A276B	O(1s)	538.7		$5\times10^3/1$	50		1176	117,600	14 Å	2.85	0.61	
A276C	C(1s)	291		$1\times10^3/2$	50		1500	15,000	15 Å	1.0	0.21	

Comments:

Figures:

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Table 11

Sample: A-276 Control
Treatment:
Date: 8-8-84

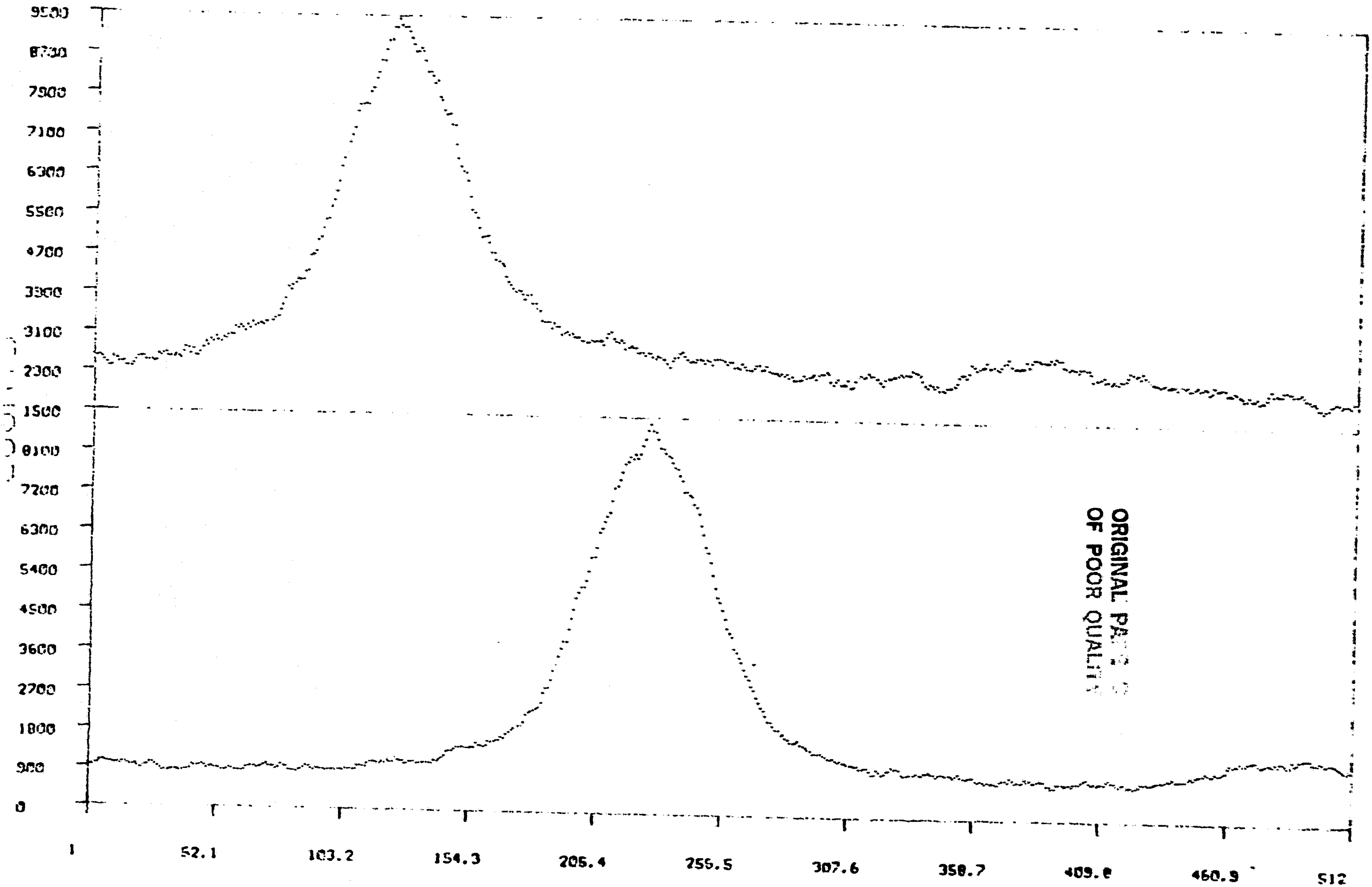
scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
A2761	Si (2p)	105.2		$5\times10^2/1$	50		1403	14,030	15 Å	0.865	0.16	
A2764	O (1s)	535.3		$5\times10^3/2$	50		1705	85,250	14 Å	2.85	0.33	
A2763	C (1s)	287.5		$2\times10^3/1$	50		1258	50,320	15 Å	1.0	0.51	

Comments:

Figures:

Ta[illegible] 12

A276 FLIGHT/CONTROL - Si 2p



CHANNELS

Fig 31

A276 FLIGHT/CONTROL - O 1s

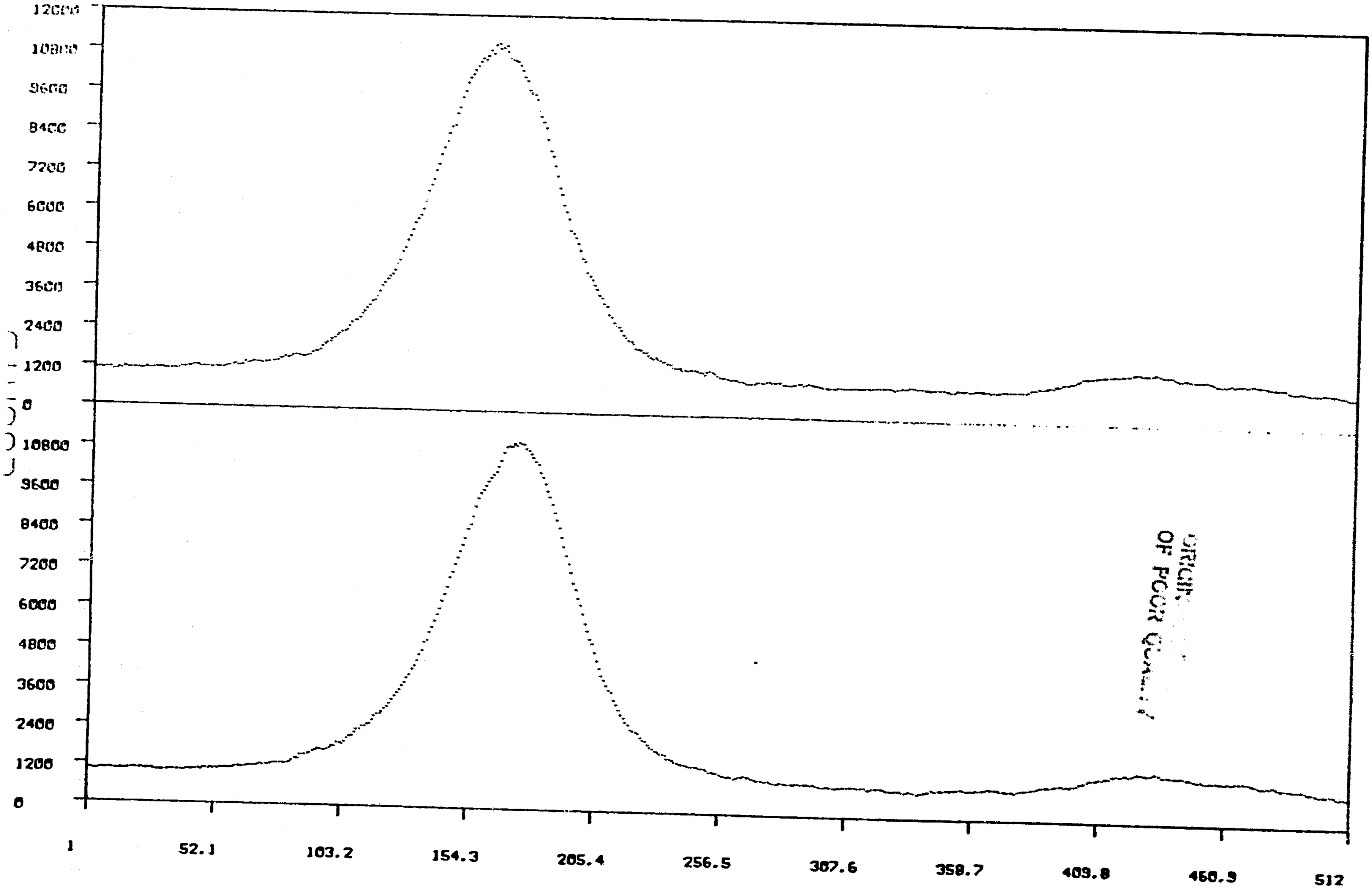
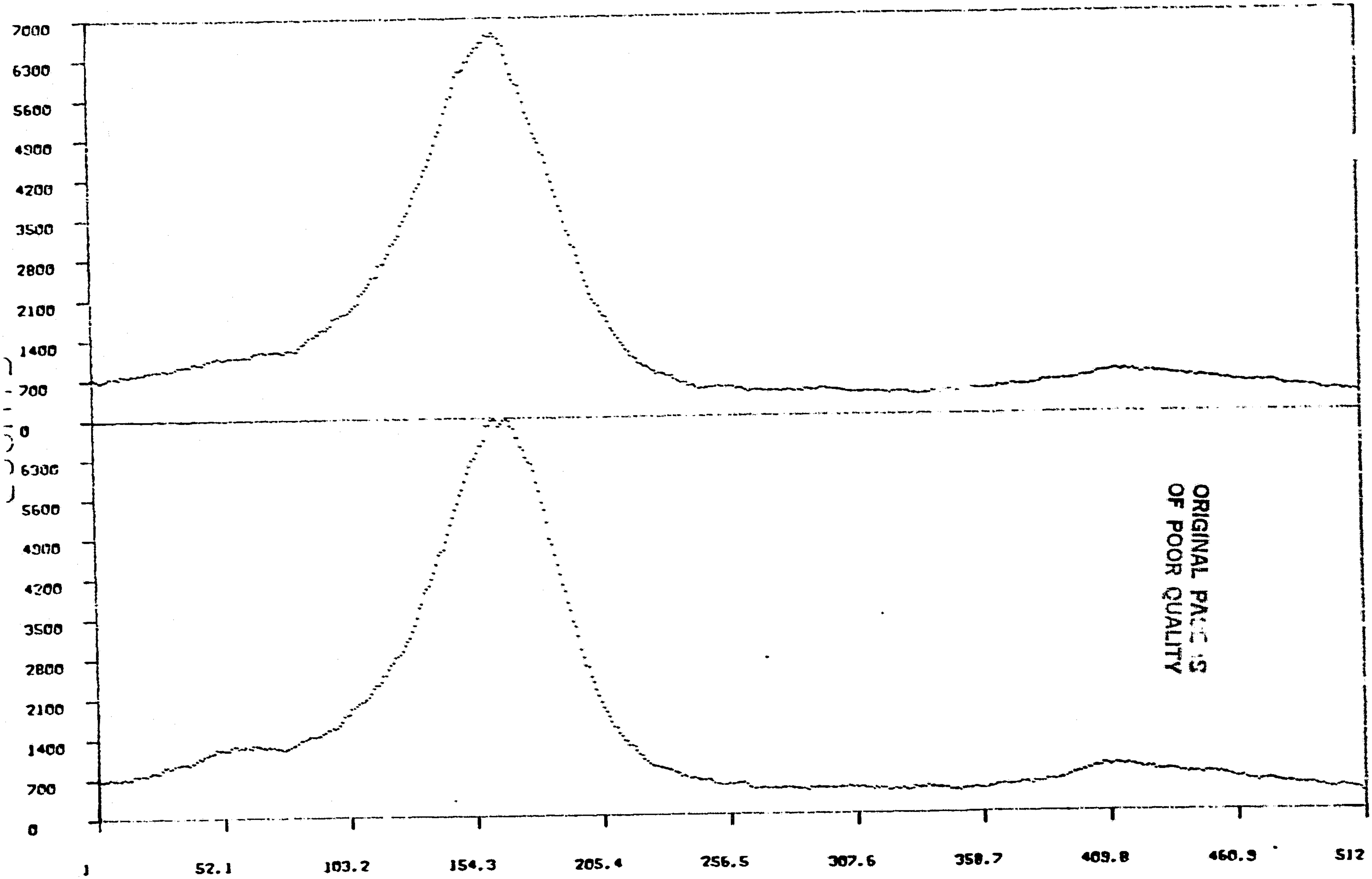


Fig 32

A276 FLIGHT/CONTROL - C 1s



CHANNELS

Fig 33

Sample: 2-302 / Flight
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
[illegible]	Si(2p)			$1\times10^3/5$	200		2879	2879	15 Å	0.865	0.05	Si
2302 F	O(1s)			$2\times10^3/1$	50		1236	49,440	14	2.85	0.27	O
2302 G	C(1s)			$2\times10^3/1$	50		1195	47,800	15	1.0	0.68	C

Comments:

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Figures:

Table 13

Sample: Z-302 Control
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
Z302A	Si(2p)	103.9		[illegible]	50		1685	3370	15	0.865	0.05	Si
Z302B	O(1s)			$2\times10^3/1$	50		875.5	35,000	14	2.85	0.17	O
Z302C	C(1s)			$2\times10^3/1$	50		1548	61,900	15	1.00	0.78	C

Comments:

Si, [illegible]

Figures:

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Table 14

Z-302 FLIGHT/CONTROL - Si 2p

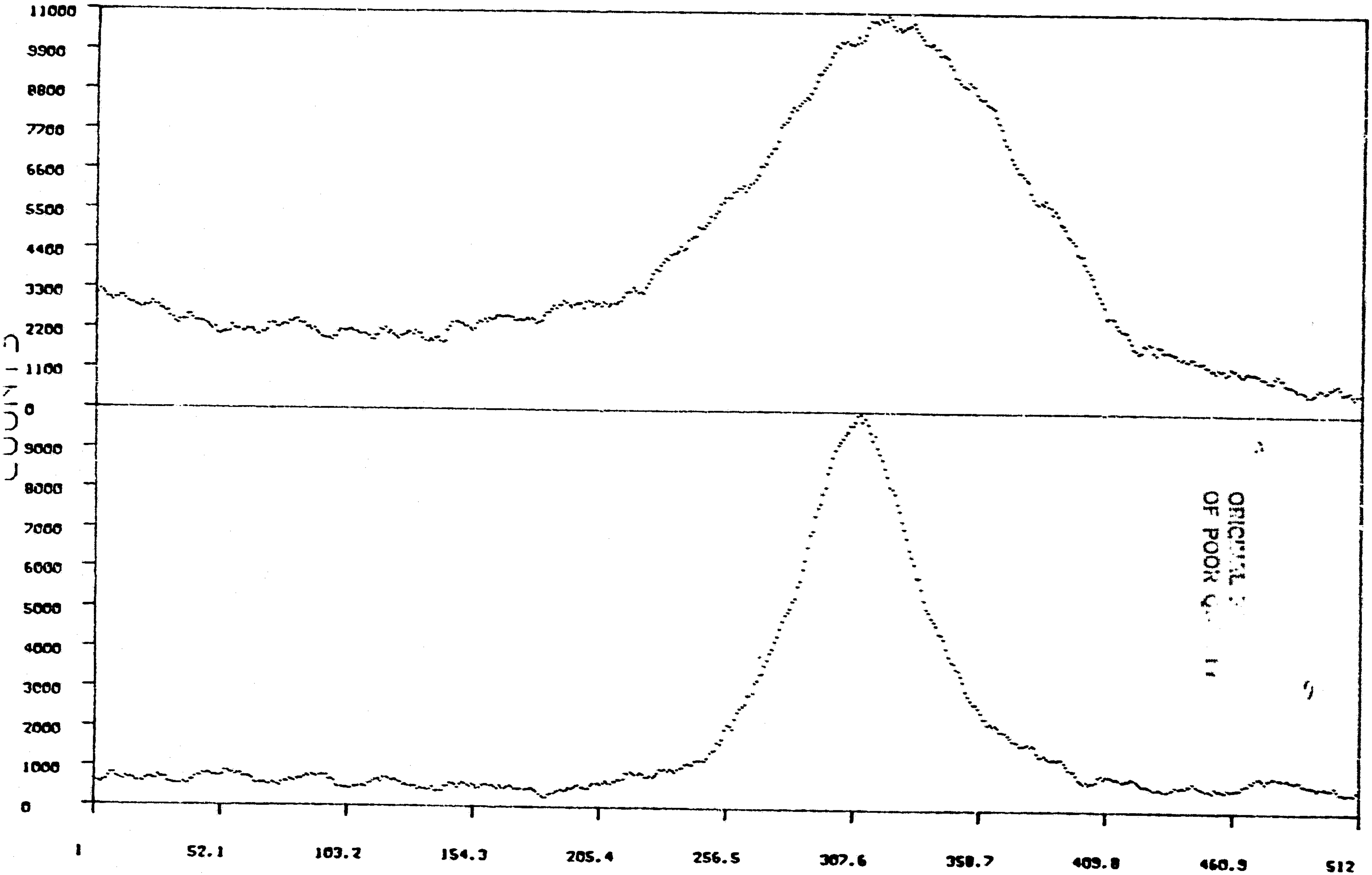


Fig 3a

Z-302 FLIGHT/CONTROL (SPUTTERED) - Si 2p

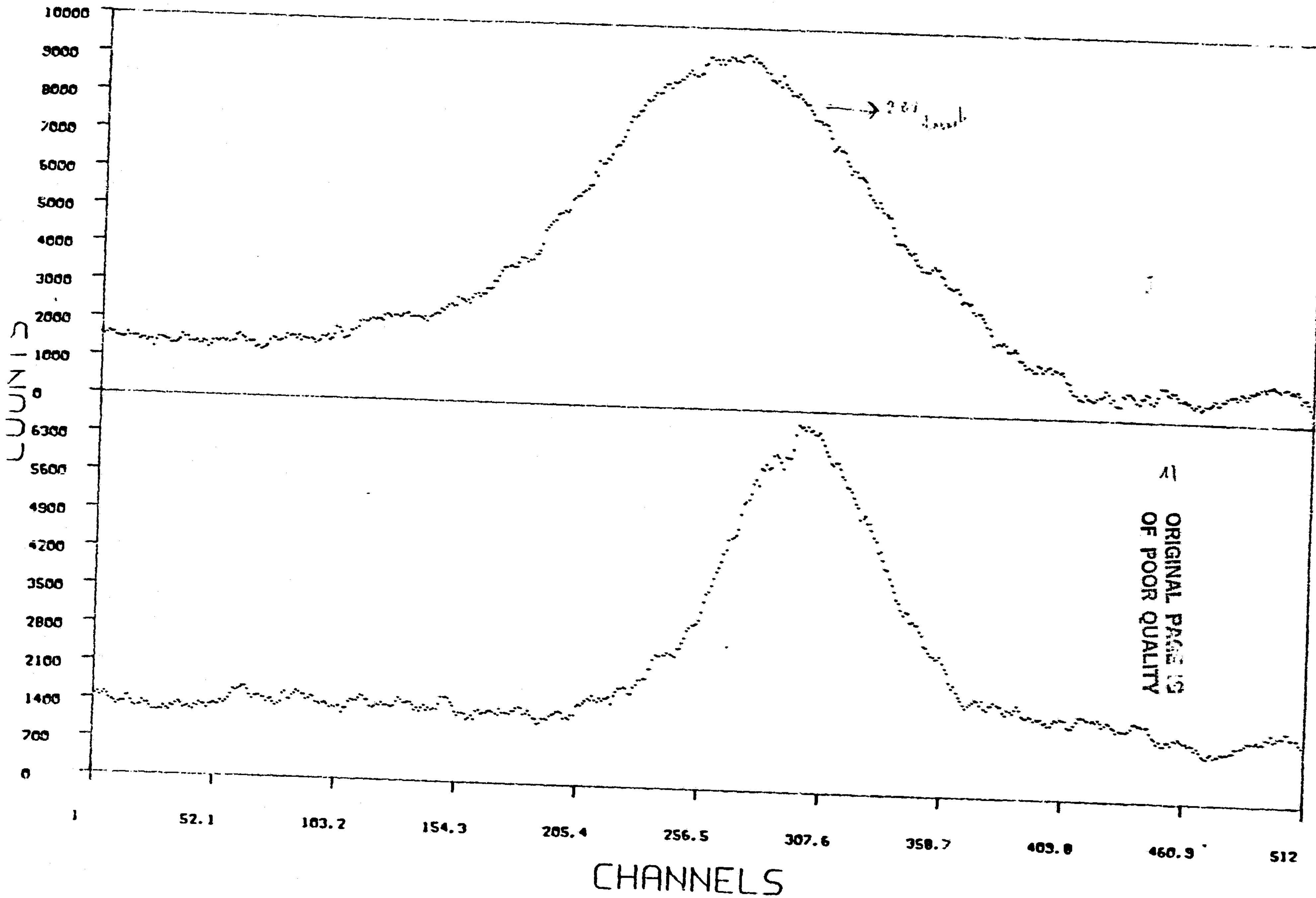
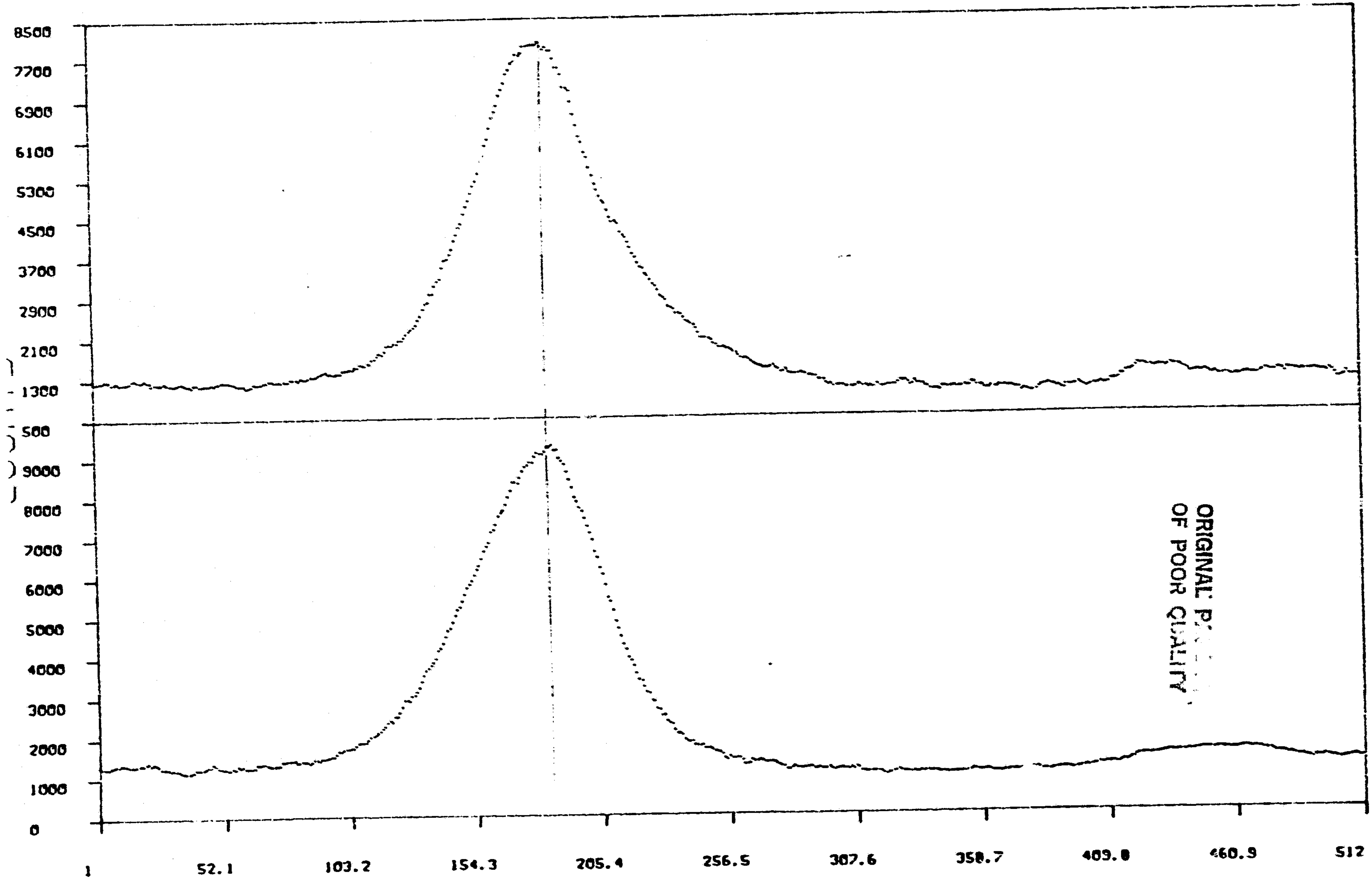


Fig 35

Z-302 FLIGHT/CONTROL - O 1s



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Z-302 FLIGHT/CONTROL (SPUTTERED) - O 1s

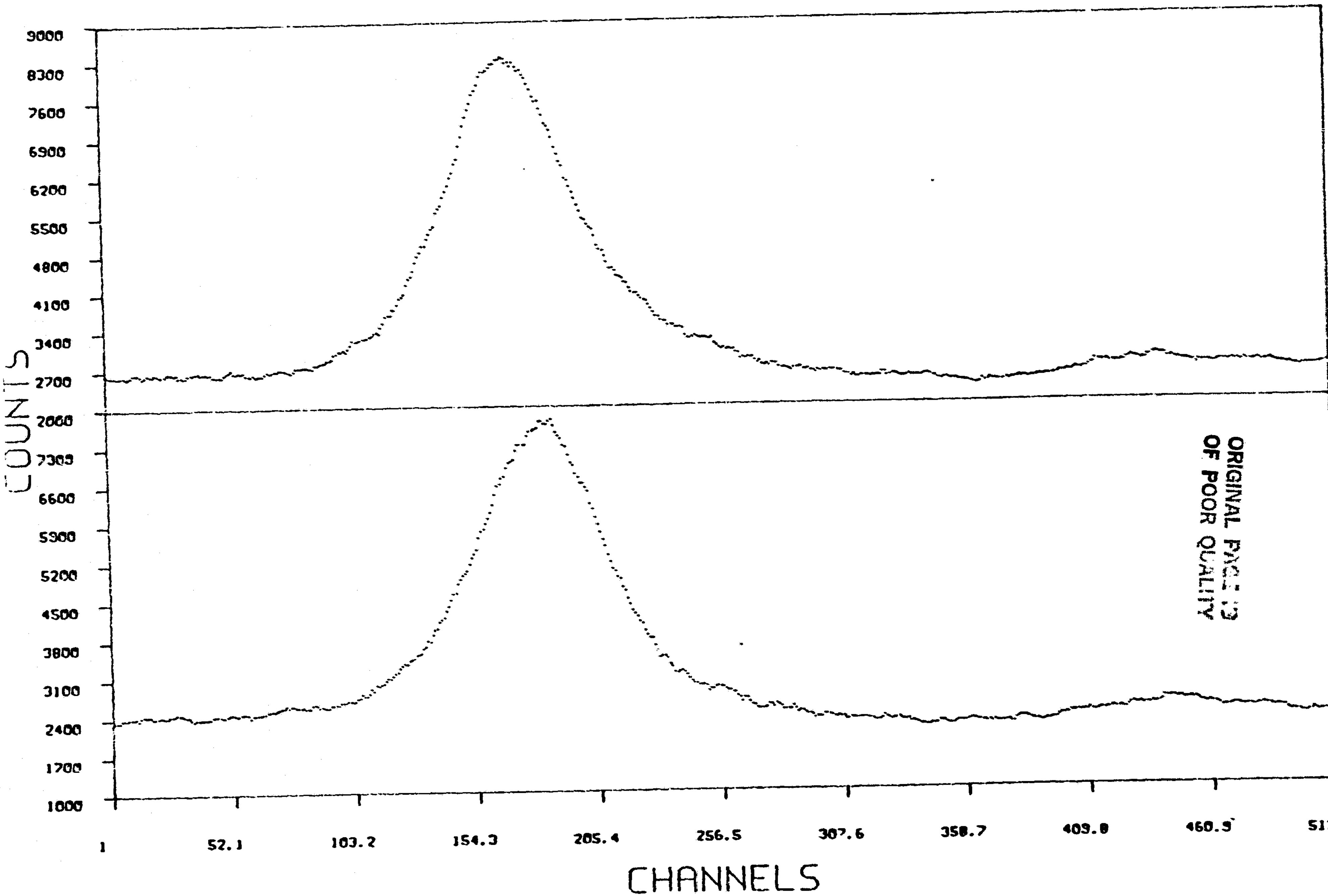
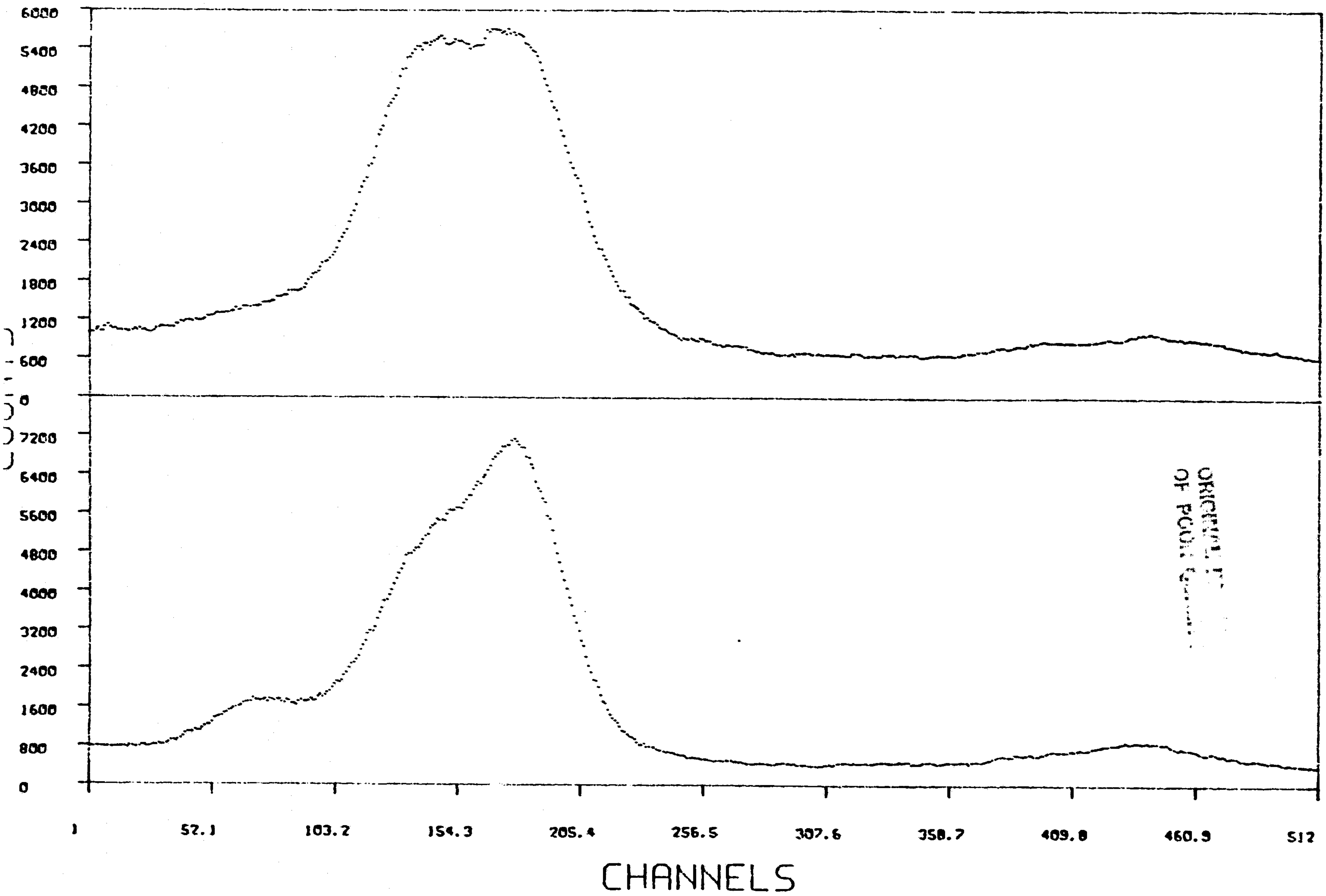
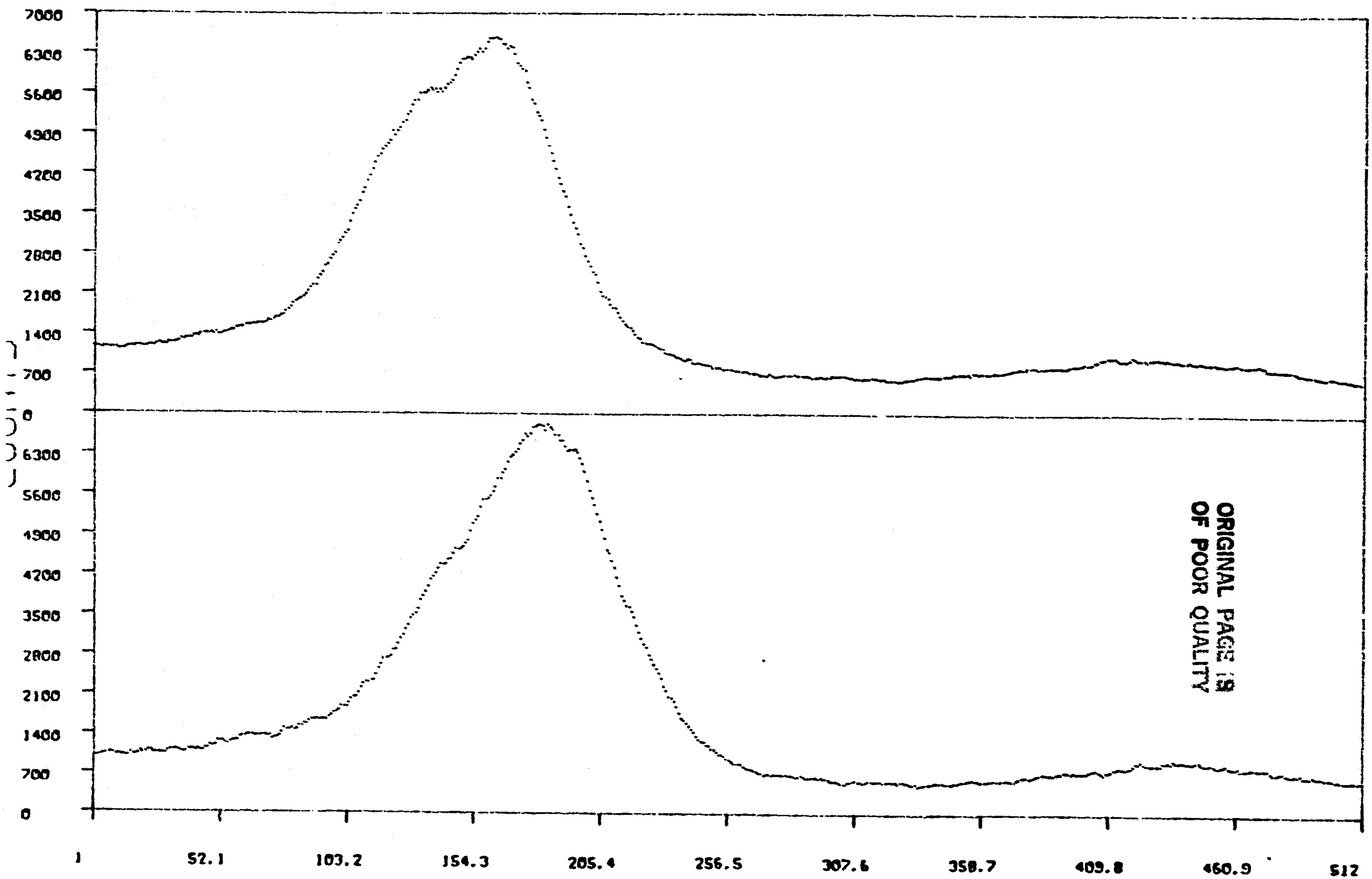


Fig 37

Z-302 FLIGHT/CONTROL - C 1s



Z-302 FLIGHT/CONTROL (SPUTTERED) - C 1s



CHANNELS

Fig 39

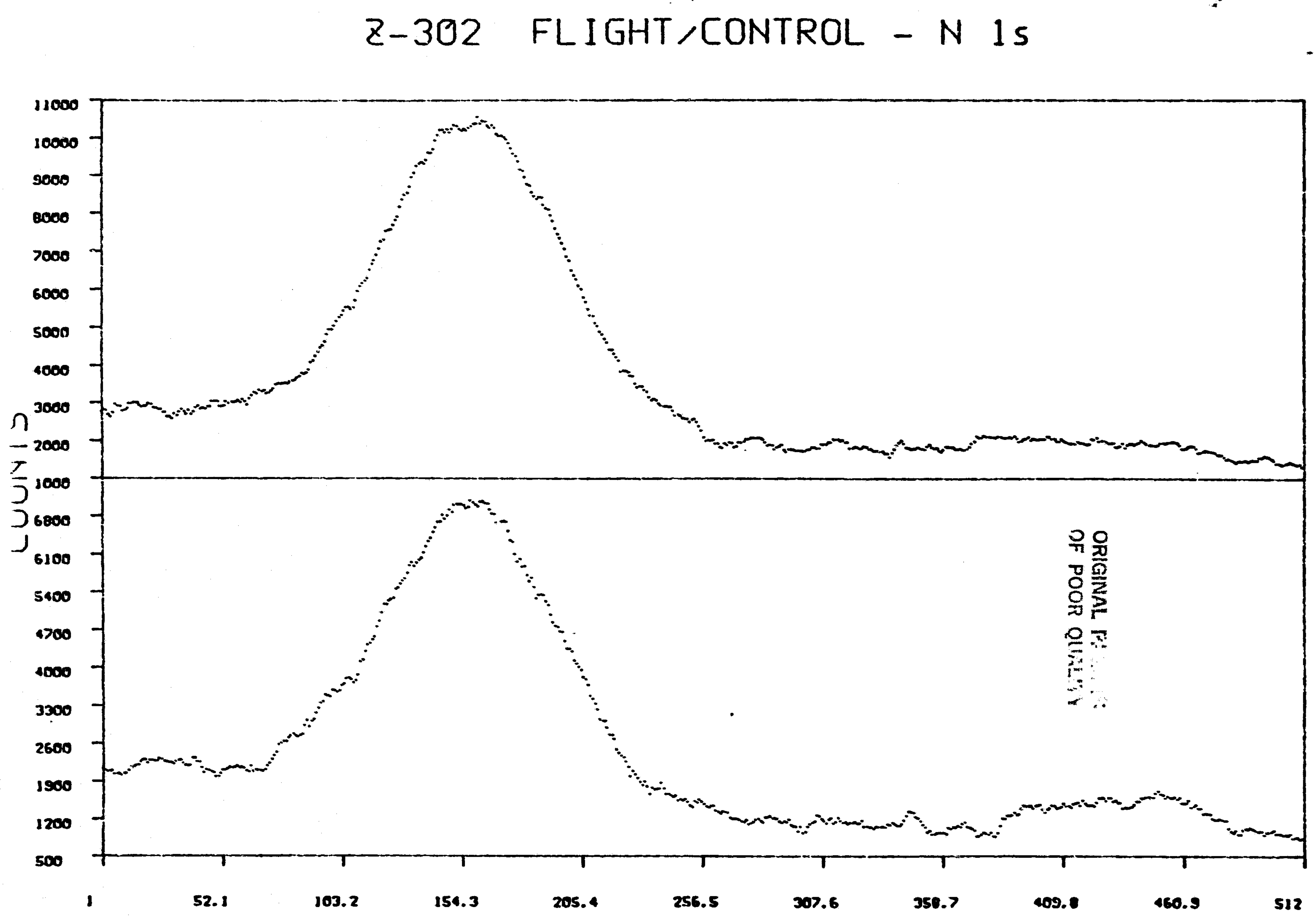

Z-302 FLIGHT/CONTROL - N 1s
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
6800
6100
5400
4700
4000
3300
2600
1900
1200
500
COUNTS
1
52.1
103.2
154.3
205.4
256.5
307.6
358.7
409.8
460.9
512
CHANNELS

Fig 40

Z-302 FLIGHT/CONTROL (SPUTTERED) - N 1s

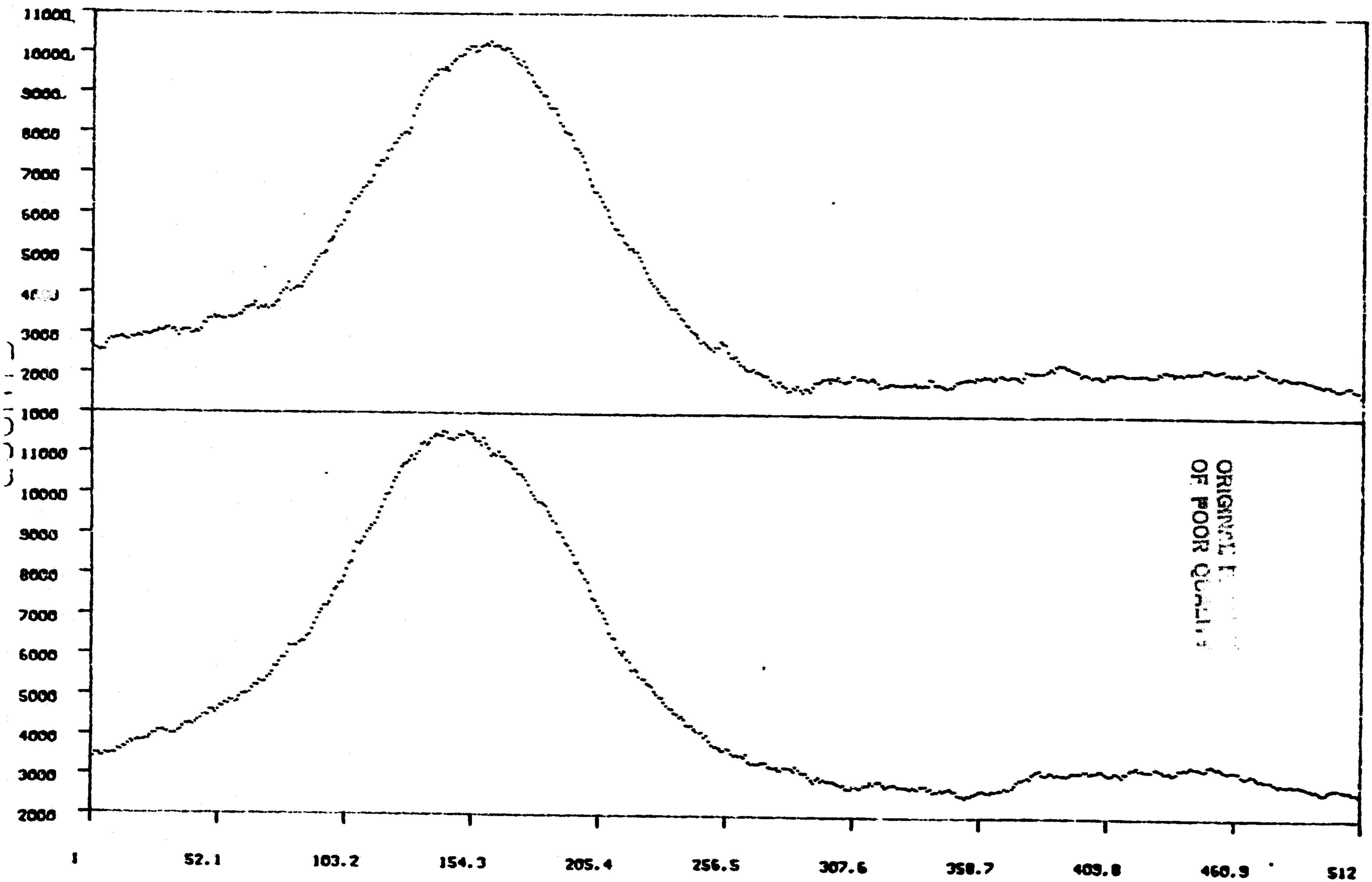


Fig 41

Sample: [illegible]-C'O Flight
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
C10 T	[illegible]			$1\times10^3/1$	50		2236	44,720	15 Å	0.865	0.42	
C10 K	[illegible]			$5\times10^3/1$	50		1575	157,500	14	2.85	0.48	
C10 L	[illegible]			$5\times10^2/2$	50		2456	12,280	15	1.0	0.10	

Comments: low Si level

Si, C, Na, Mg, [illegible], [illegible]

Figures:

Table 15

Sample: 401 - C10 [illegible]
Treatment:
Date:

scan	peak	B.E. (eV)	ch. #	inten.	E_0 (eV)	height (counts)	area	norm. area	escape depth	cross sect.	mole frac.	
C10 A	Si(2p)			$1 \times 10^2/1$	50		1732	3464	15 Å	0.865	0.04	
C10 B	O(1s)			$2 \times 10^3/1$	50		1988	79,520	14	2.85	0.32	
C10 C	C(1s)			$2 \times 10^3/1$	50		1510	60,400	15	1.0	0.64	

Comments:

Si, [illegible]

Figures:

Table 16

401-C10 FLIGHT/CONTROL - O 1s

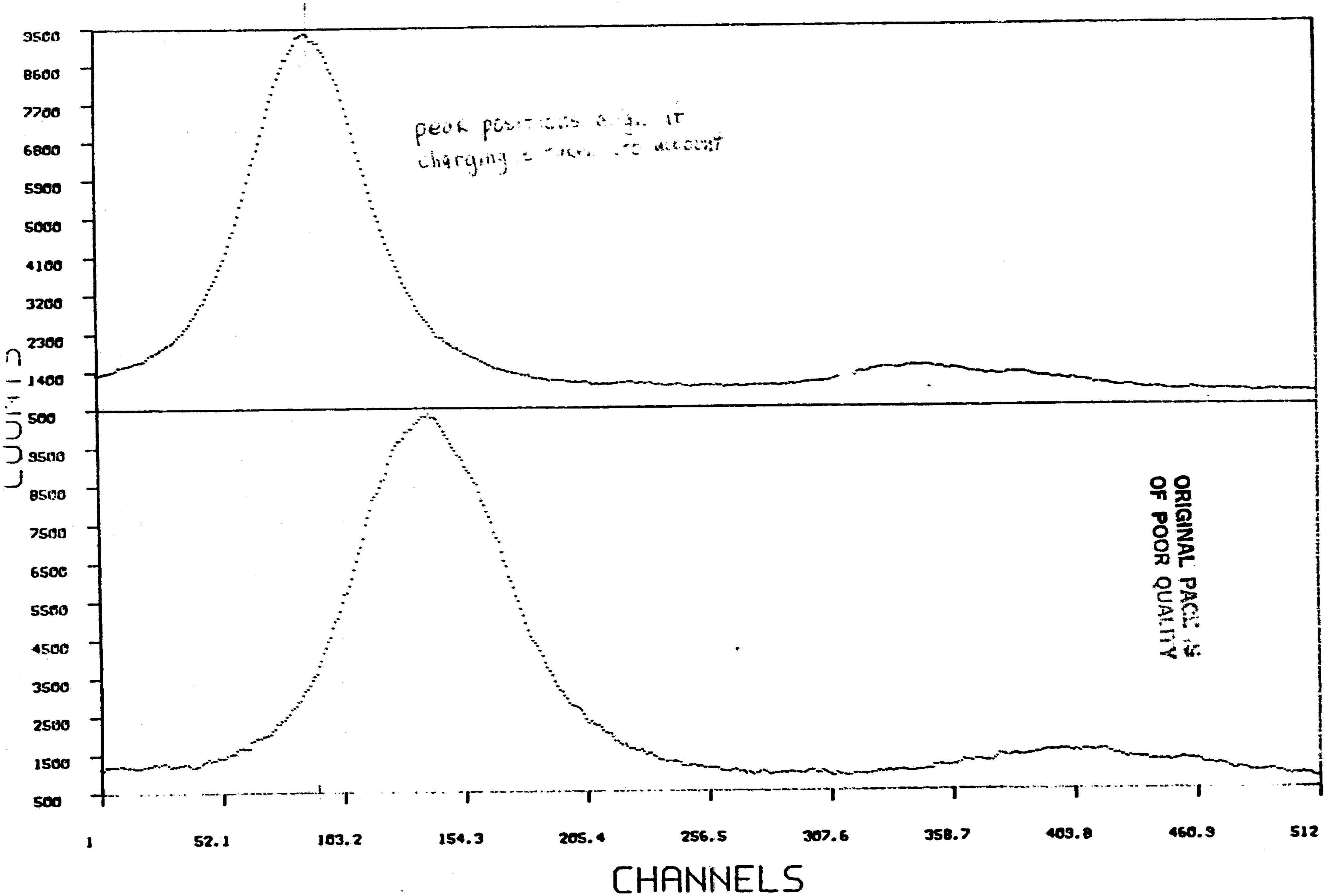


Fig 42

401-C10 FLIGHT/CONTROL (SPUTTERED) - O 1s

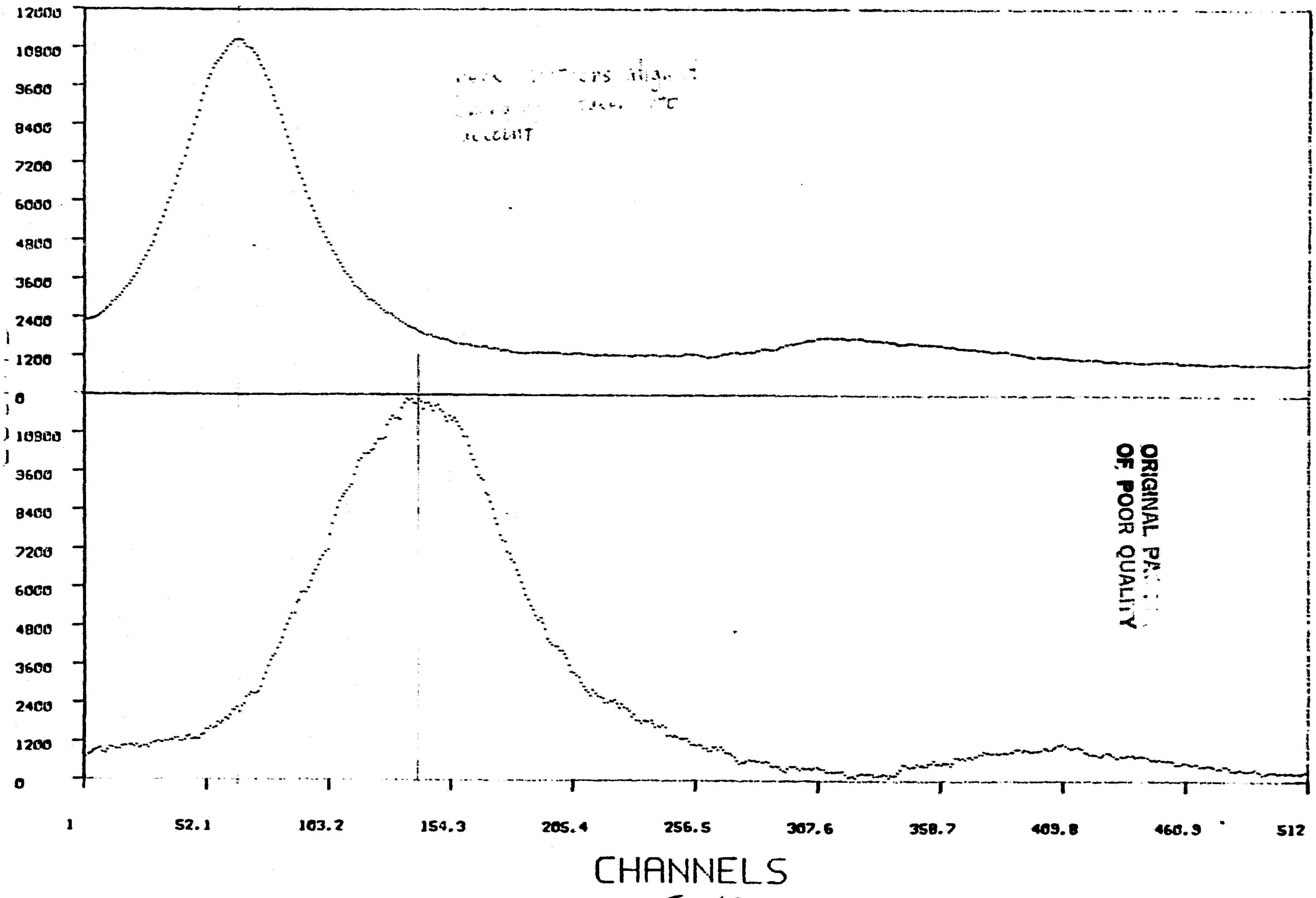


Fig 43

410-C10 FLIGHT/CONTROL - Si 2p

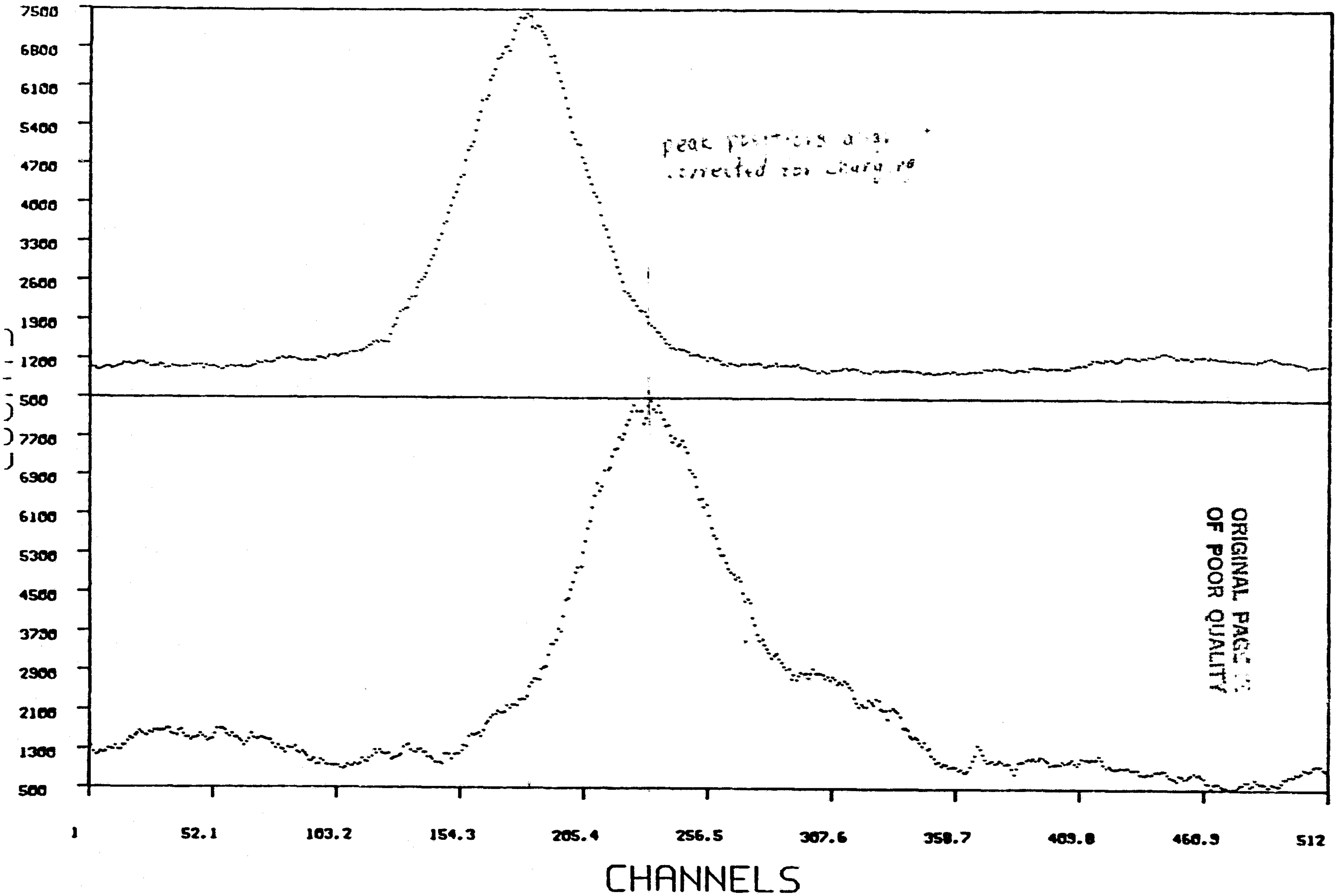
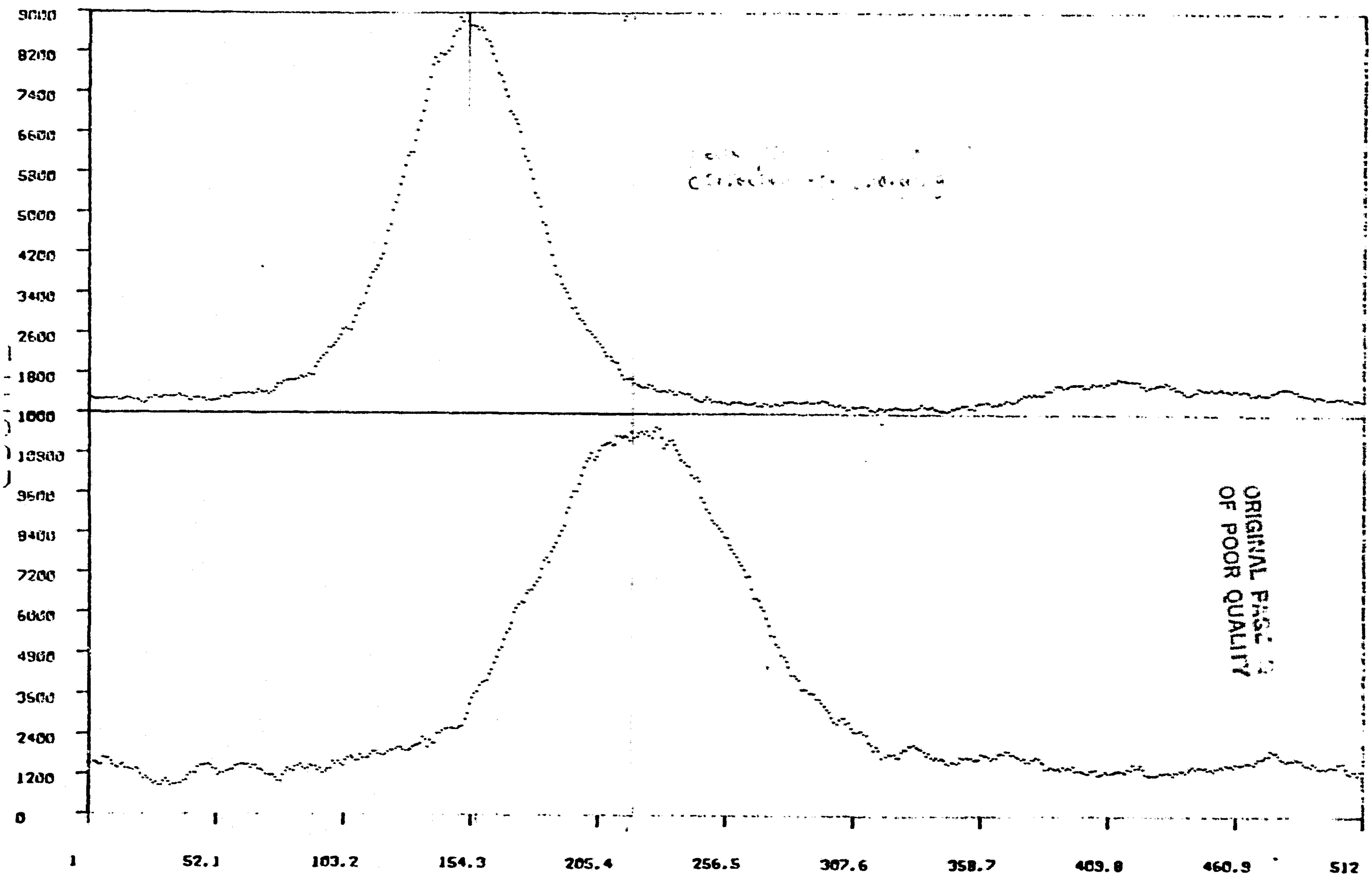


Fig 44

401-C10 FLIGHT/CONTROL (SPUTTERED) - Si 2p



CHANNELS

Fig 45

410-C10 FLIGHT/CONTROL - C 1s

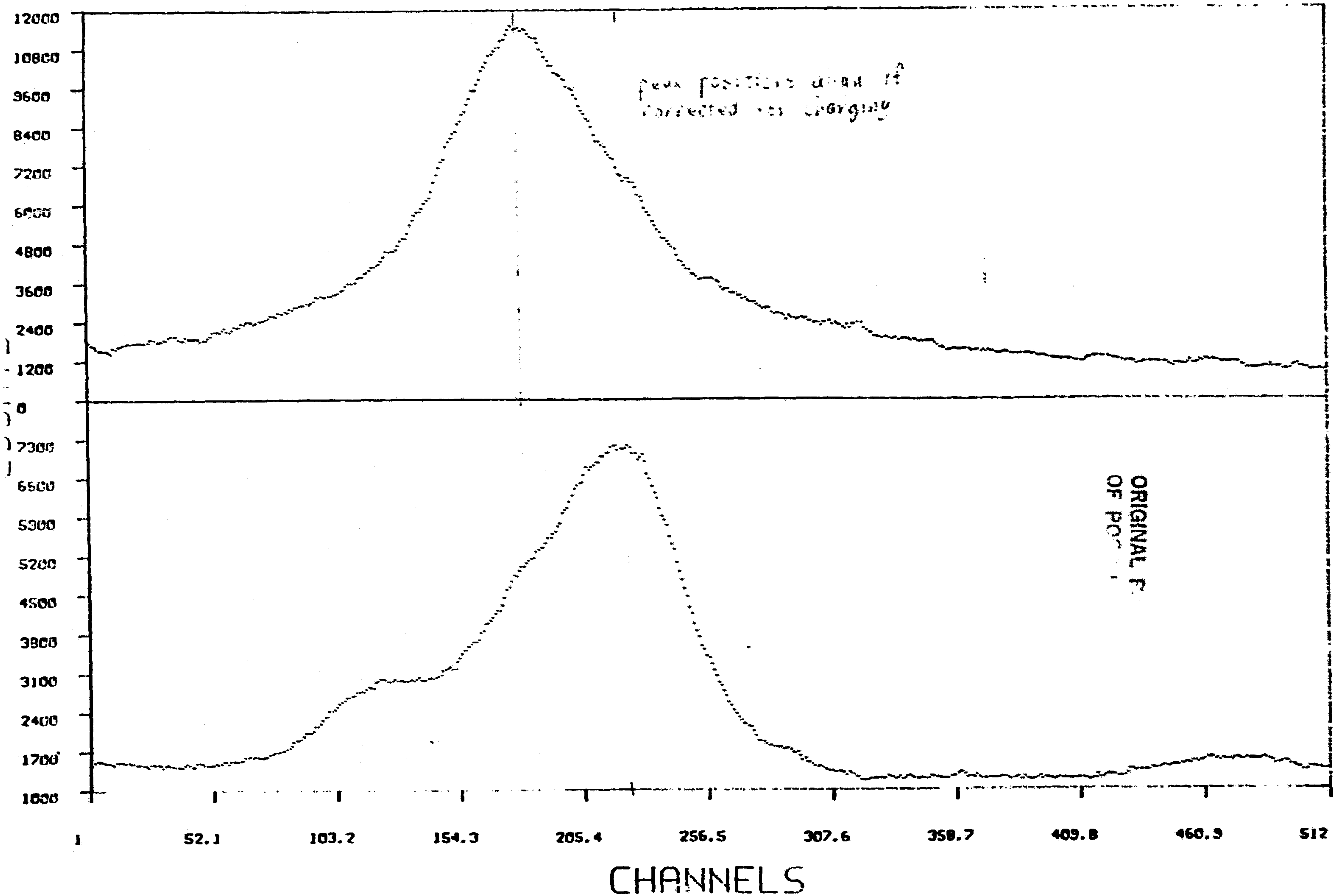
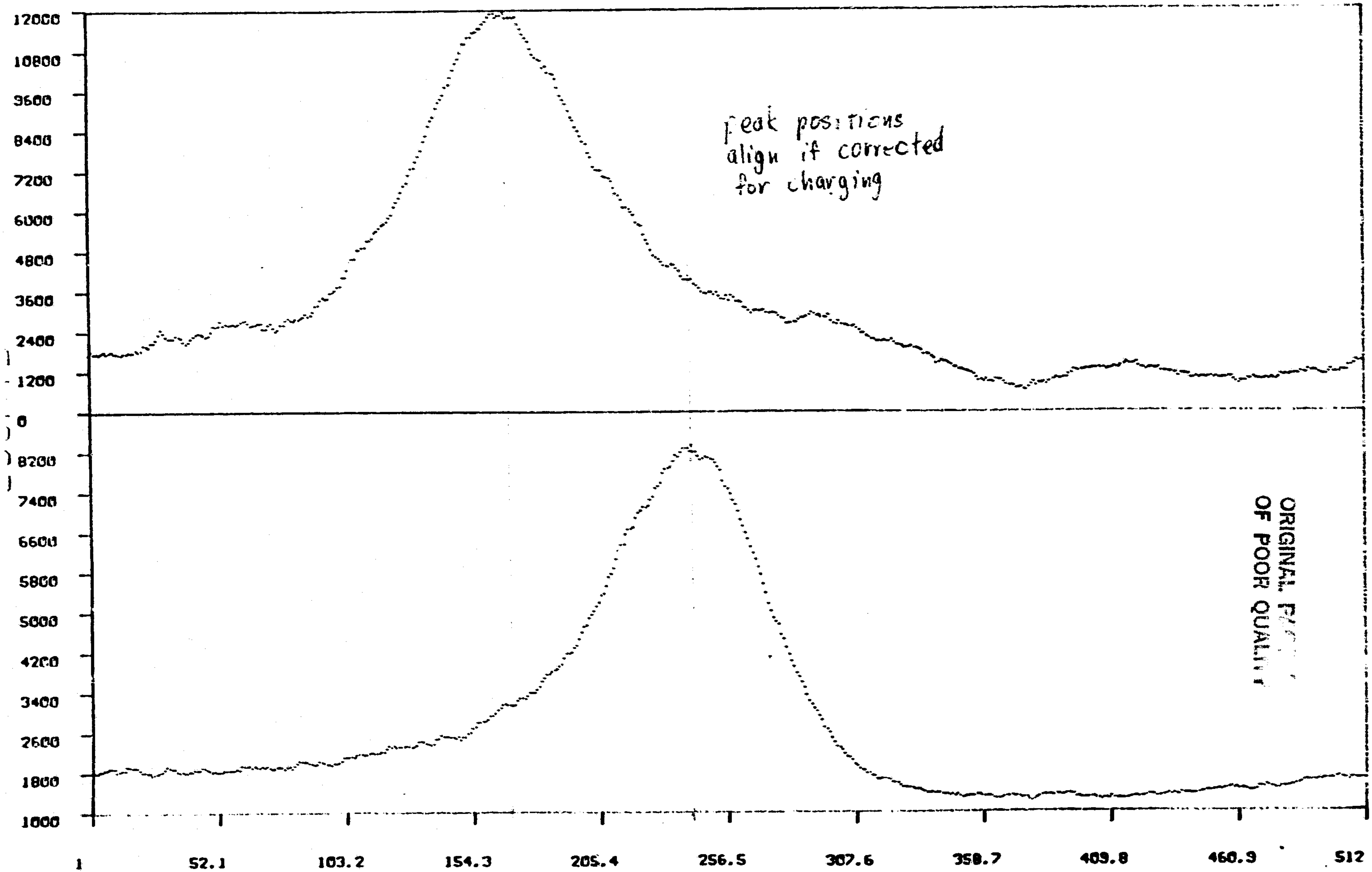


Fig 46

401-C10 FLIGHT/CONTROL (SPUTTERED) - C 1s



CHANNELS

Fig 47