

# **ARTS2282**

FcaY

GYa YghYf'CbY''##'&\$%

: cf`YggYbhJU``ghi XYbh`]bZcfa UhJcb`fY`UhJb[`hc.`fYei Yghg`Zcf`Yl hYbg]cb/fYj ]Yk `cZa Uf\_g/cWW dUhJcbU``\YU`h\UbX`gUZ/hm/Yl Ua ]bUhJcb'dfcWXi fYg/gdYVJU``Wcbg]XYfUhJcb`]b`h\Y`Yj YbhcZ]``bYgg`cf`a ]gUXj Ybhi fY/ghi XYbhYei ]hm'UbX`X]gUV]`]hm'UbX`ch\Yf`YggYbhJU``UWUXYa ]W]bZcfa UhJcbž gYY`\hdg.#k k k "Ufhg"i bgk "YXi "Ui #W ffYbhghi XYbhg#JWUXYa ]W]bZcfa UhJcb#dfchcWc`g![i ]XY`]bYg#

### 7ci fgY'8YW]`g

7 fYX]hDc]bhg \*

Gi a a UfmcZh\Y 7ci fgY

Gi VYWh5fYU.: [efack

H\]g`Wci fgY`lfUV\Yg`h\Y`f]gY`cZF ca Y`Zfca `U`ga U```W]lm\glUh\Y`lc`h\Y``Uf[Yghdck Yf`]b`h\Y`A YX]lh\YffUbYUb k cfX"`=b`]h\wci `k ]``YI d`cfY`h\Y`dc`]h\WJ`\zgcW]U``UbX`W``h fU``XYj Y`cda YbhcZF ca Ub`W]j ]`]gUh]cb`Zfca `+) ' 679 'hc') \*) '79"'\Mci `k ]```YUfb`\ck `F ca Y`Ug`U`ghUh\Y`UbX`dYcd`Y`XYU`hk ]h\`]b\YfbU``WcbZ]\WhUbX`YI h\YfbU``UXj Yfg]h]\Yg`UbX`Yj Ybhi U``mlrfUbgZcfa YX`Zfca `U`d`i fU`]gh]\WghUh\Y`]bhc`Ub`Ui hc\WfUh]\WYa d]f\Y"`H\]g`\Wci fgY YI Ua ]b\Yg`F ca Yfig`dc`]h]\WJ``\]ghcfm\zUg`k Y```Ug`]\ng`gc\W]U``UbX`\W``hi fU```]ZY`UbX`]\ng`fY`Uh]cbg\]dg`k ]h\`ch\Yf \W``hi fYg"

#### 5 hh Y WcbWi g]cb cZh ]g Wci fgY h Y gh XYbhk ] ` VY UV Y hc

%" 5 bU`mgY`]a dcftUbhih fb]b[ 'dc]bhgždYcd`Yž]XYUg`UbX`XYj Y`cda Ybhg`fY`Yj Ubhihc`F ca Ub`\]ghcfm &" 8 YgWf]VY`h\Y`UbW]YbhiUbX`a cXYfb`[ Yc[ fUd\mcZ9i fcdYžBcft\\ '5 Zf]WUž'h\Y`A YX]hYffUbYUb`6Ug]bž UbX`h\Y`A [XXY`9 Ugh"

' " @cWUhY UbX UbU`mqY fY Yj Ubhdf]a UfmUbX gYWcbXUfmgci fWyg

("7cbglfi WhWc\YfYbhUf[iaYbhg

#### HYUWX]b[ GhfUhY[]Yg

 $H\[g'WcifgY']g'XYg][bYX'hc']bhfcXi\WY'ghiXYbhg'hc'\_Ym'\]ghcf]WU''Yj\Ybhg'UbX'\]ghcf]c[fUd']WU''h\Ya\Yg']bFcaUb'\]ghcfm''.7 cbhYbhk ]```VY'XY']j\YfYX']b''YWifYgžUbX'h\fci[\'fYUX]b[g'X]gW\ggYX']b''h\rangle g''X]gW\ggYX']b''h\rangle g''XgUm'UbX'Ughcfm'h\fci[\'Ub']bXYdYbXYbhfYgYUfW\'YggUm'UbX'UgYf]Yg'cZei]nnYg'hYgh]b['_bck 'YX[Y'cZ'YWfifYg'UbX'fYUX]b[g''$ 

## 5ggYgga Ybh

8YHJ]YX`]bZcfa Uf]cb`cb`U```UggYgga Ybfg`]g`Uj U]`UV`Y`cb`A ccX`Y"

#### 5ggYgga Ybh'HUg\_g'

5ggYgga Ybh'hJg_	K Y][\h	8i Y'8UHY	Gh XYbh@YUfb]b[ Ci hWca Ygʻ5ggYggYX
Hi hcf]U``YggUmi	' \$1	J Uf]UV`Y	%Ž Ž(
Ei]n	&\$I	K YY_', 'UbX'K YY_'‰	%ž&
F YgYUfWX 'YggUm'	) \$1	\$%#\$*#&\$% `\$(.\$\$`DA	%Ž Ž(

#### 5ggYgga Ybh'8YhJ]`g

5ggYgga Ybh% Hi hcf]U`YggUm

GHJfhXUhY. Bch5dd`]WUV`Y

**@Yb[h**\. \%\$\$ k cfXg

**8YHU]`g.** '%\$\$\$`k cfX`\]ghcf]\\\'`YggUmfY`Uh]b[ 'hc'U'h hcf]\\'`hcd]\\''8i Y'\Y\ZcfY'h\Y'fY`Yj Ubhih hcf]\\'''H\Y'YggUm k]```\Y'[ fUXYX\Z'UbX'\ZYYX\U\\\\_[] j Yb'\mU'fi \Vf]\\UbX'k f]\hYb'\\da a Ybhg'''

#### 5XX]h]cbU`XYhU]`g.

Hi fb]h]b'gYh]b[.'H\]g'Ugg][ba Ybh]g'gi Va ]hhYX'h\fci [\'Hi fb]h]b'UbX'gh XYbhg'Xc'bchgYY'Hi fb]h]b g]a ]'Uf]hmfYdcfhg"

5ggYgga Ybh& Ei]n

GhUfhXUhY. Bch5dd`]WUV`Y

8 YHJ]`g. '9bX'cZhYfa 'ei ]n'! '5 'a ]l 'cZg\cfhUbgk Yf'd`i g'dUfU[ fUd\'fYgdcbgYg"' 'f0%\$\$\$'k cfXg']b'hcHJ`Ł" H\YgY'k]``VY'[ fUXYXžk ]h\ Vf]YZWca a Ybhg'cb'fYei Ygh''

#### 5XX]h]cbU`XYhU]`g.

5g'h\Y'5BN57'XUmdi V`]W\c`]XUmf&) !5df\L'U'h\fg'h\Y'f\angle ]b['cZ`\Y\Mi f\Yg']b'&\%\\\Zcfa'cZh\c'ei]nn\Yg''9U\X'ei]n']g'\kcfh\'%\| "

8YHJ]`g'UfY'Uj U]`UV`Y'cb'A ccX`Y"

Hi fb]hjb gYhjb[. H\]g ]g bchU Hi fb]hjb Ugg][ ba Ybh

5ggYgga Ybh' . F YgYUfVX YggUm

GhUfhXUhY. Bch5dd`]WUV`Y

@Yb[h\. &&) \$ k cfXg

5XX]h]cbU`XYhU]`g.

Hcd]Wg UfY dfcj ]XYX cb A ccX`Y"

#### Gi Va ]gg]cb cZ5ggYgga YbhHUg\_g

Gh XYbhg UfY Yl dYWYX hc di hh\Y]f bUa Yg UbX gh XYbhbi a VYfg cb Yj YfmdU[Y cZh\Y]f Ugg][ ba Ybhg"

#### Hi fb]h]b Gi Va ]gg]cb

#mci YbWci bhYf'U'dfcV'Ya 'k \Yb'UthYa dr]b[ 'rc'gi Va ]hmci f'Ugg][ ba Ybht\fci [ \'Hi fb]r]bž'd'YUgY
hY'Yd\cbY'9I hYfbU'Gi ddcfhcb'-', ) '''' %cf'Ya U]''h\Ya 'cb'<u>Yl hYfbU'hY'hgi ddcfh4 i bgk "YXi "Ui"</u>"'Gi ddcfh
\ci fg'UfY', .\$\$Ua '-'%\$.\$\$da 'cb'k YY\_XUmg'UbX'-.\$\$Ua '-').\$\$da 'cb'k YY\_YbXg'fl \*) 'XUmg'U'mYUft\"'=\maintention
UfY'i bUV'Y'hc'gi Va ]hmci f'Ugg][ ba YbhXi Y'hc'U'ZJi 'hk ]h\'Hi fb]h]b'mci 'a Um'Udd'm\Zcf'Ub'YI hYbg]cb\ZVi hmci
a i ghfYhJ]b'mci f'h]\W\_Yhbi a VYf\Zfca '9I hYfbU''Gi ddcfhfU'cb[ 'k ]h\'Ubmch\Yf'fY'Yj UbhXcW'a Ybhgt'hc
]bWi XY'Ug'Yj ]XYbW' hc'gi ddcfhmci f'Yl hYbg]cb'Udd']\WJh]cb'''=\maintention 'Ya U]''9I hYfbU''Gi ddcfhmci 'k ]'`
Ui hca Uh]\WJ'`mfY\W']j Y'U'h]\W\_Yhbi a VYf\ZVi h]Zmci 'hY'Yd\cbY'mci 'k ]'\'bYYX'hc'gdY\W]\Z\WJ'`mUg\_'Zcf'cbY''
Hi fb]h]b'U'gc'dfcj ]XYg'i dXUhYg'cb'h\Y]f'gmghYa 'ghUh' g'cb'Hk]hYf''

; YbYfU`mž'UggYgga YbhitUg\_g'a i ghVY'gi Va ]hhYX'Y`YWfcb]WU``mj ]U'Y]h\Yf'Hi fb]h]b'cf'U'A ccX`Y Ugg][ ba Ybh''=b']bghUbWfg'k \YfY'h\]g']g'bchdcgg]V`Yž']hk ]```VY'ghUhYX'cb'mci f'Wci fgY'g'A ccX`Y'g]hY'k ]h\U`hYfbUh]j Y'gi Va ]gg]cb'XYhU]`g"

#### @UhY 5ggYgga Ybh'DYbU`h]Yg

5b'UggYggYX'HUg\_']g'XYYa YX``UhY']Z]h']g'gi Va ]hhYX'UZhYf'h\Y'gdYW]Z[YX'h]a Y'UbX'XUhY'Ug'gYhci h']b'h\Y Wci fqY'@YUfb]b['A UbU[Ya YbhGmqhYa 'f@A GŁ"

$$\label{thm:condition} \begin{split} &\text{H}^{\text{U}$$

K cf\_'gi Va ]hhyx'zci fhyyb'fl%( EXUmg'Uzhyf'h\y'Xi Y'XUhy'k ]``VY'a Uf\_YX'UbX'zYYXVUW\_'dfcj ]XYX'Vi hbc'a Uf\_ k ]``VY'fYWcfXYX"'=Zh\Y'k cf\_'k ci `X'\Uj Y'fYWr]j YX'U'dUgg'a Uf\_'Vi hzcf'h\Y'`UhybYgg'UbX'h\Y'k cf\_']g'U Wca di `gcfm'Wci fgY'Wca dcbYbhz'U'gh XYbh'k ]``VY'XYYa YX'hc'\Uj Y'a Yhih\UhfYei ]fYa Ybh''H\]g'XcYg'bch Udd`mhc'U'hUg\_'h\Uh']g'UggYggYX'Vi hbc'a Uf\_']g'Uk UfXYX"

K cf\_'gi Va ]hh/X'hk YbhnlcbY'f&&XUmg'UZhYf'h\Y'Xi Y'XUhY'k ]```bchVY'UWWdhYX'Zcf'a Uf\_]b[ 'cf'ZYYXVUW\_UbX'k ]```fYWY]j Y'bc'a Uf\_'cf'[ fUXY"'=Zh\Y'UggYgga YbhhUg\_']g'U'Wca di `gcfmWca dcbYbhcZh\Y'Wci fgY'Ugh XYbhk ]```Ui hca Uh]WU``mZU]`'h\Y'Wci fgY"

#### GdYWJU`7cbg]XYfUhJcb55dd`]WUhJcbg

 $\label{eq:linear_continuity} $$Mc_i = W_0 - W_$ 

G]W\_bYggža ]gUXj Ybhi fY'cf'ch\Yf'W]fW a ghUbWrg'VYmcbX'mci f'Wcbhfc``a Um

ł DfYj Ybhimci Zfca Wca d`Yhlb[ U.Wci fqY fYei ]fYa Ybhž

ł? YYd mci Zfca 'UthYbX]b[ 'Ub 'UggYggUV'Y 'UWnji ]tmž

ł Ghod moi gi Va ]hh]b[ 'UggYggUV'Y k cf\_ Zcf'U Wci fgYž

ł `G][ b]Z]\WbhmUZZY\Wimci f`dYfZcfa Ub\Wr`]b`UggYggUV`Y`k cf\_ž`VY`]h'U`Zcfa U``YbX!cZgYa YghYf`Yl Ua ]bUh]cbž`U \WUgg`hYghž`U``UVcfUhcfmhYghž`U`gYa ]bUf`dfYgYbhUh]cb`cf`Ubmch\Yf`Zcfa 'cZUggYgga Ybh'

#### 5 WUXYa ]W<cbYghmUbX D`U[ ]Uf]ga

D`U[]Uf]ga `]g`i g]b[ 'h\Y`k cfXg`cf`]XYUg`cZch\Yfg`UbX`dfYgYbh]b[ 'h\Ya `Ug`mci f`ck b"'\lefi\Wb'hU\_Y`a Ubm Zcfa gžZfca `XY`]VYfUhY`W\YUh]b[ 'hc`UVW]XYbhU`mWcdm]b[ 'Zfca `U`gci f\W' k ]h\ci hUW\_bck `YX[ Ya Ybh'

IBGK [fcidgdu[]uf]ga ]bhch\YZc``ck]b[ WuhY[cf]Yg.

7 cdm]b[.'i g]b['h\Y'gUa Y'cf'j Yfmg]a ]`Uf'k cfXg'hc'h\Y'cf][]bU`hYl h'cf']XYU'k ]h\ci h'UW\_bck `YX[]b['h\Y gci fW'cf'i g]b['ei chUh]cb'a Uf\_g"'H\]g'U`gc'Udd`]Yg'hc']a U[Ygž'Ufh'UbX'XYg][b'dfcYWhgž'Ug'k Y``'Ug dfYgYbhUh]cbg'k \YfY'gca YcbY'dfYgYbhg'Ubch\Yf'g']XYUg'cf'k cfXg'k ]h\ci h'WfYX]h'

±DUddfcdf]UhY`dUfUd\fUg]b[.'W\Ub[]b['U'ZYk'kcfXg'UbX'd\fUgYg'k\]`Y`acghmfYhJ]b]b['h\Y`cf][]bU`ghfi WhifY`UbX`]bZcfaUh]cb`k]h\ci hUW\_bck`YX[YaYbh'H\]g'U`gc'Udd`]Yg`]b'dfYgYbhUh]cbg'k\YfY`gcaYcbYdUfUd\fUgYg`Ubch\Yf'g`]XYUg`cf'kcfXg'k]h\ci hWfYX]h''±iU`gc'Udd`]Yg`hc'd]YW]b['hc[Yh\Yf'ei chYg'UbXdUfUd\fUgYg`]bhc'U'bYk'k\c`Yžk]h\ci hfYZ/fYbW]b['UbX'U'ghi XYbh'g`ck b'UbU`mg]g`hc'Vf]b['h\Y`aUhYf]U`hc[Yh\Yf''

7 c``i g]cb. 'k cf\_]b[ 'k ]h\ 'ch\ Yfg'Vi h'dUgg]b[ 'c\Z'h\ Y 'k cf\_'Ug'U'dYfgcb'g']b\X]j ]\Xi U``k cf\_"'7 c``i g]cb'U`gc ]b\Wi XYg'dfcj ]\X]b[ 'mci f'k cf\_'hc'Ubch\ Yf'ghi XYbh\ VYZcfY'h\ Y 'Xi Y 'XUhYzcf'Zcf'h\ Y' di fdcgY'cZh\ Ya d`U[ ]\Uf]g]b[ 'Uh\Ubmh]a Yz'dUm]b[ 'Ubch\ Yf'dYfgcb'hc'dYfZcfa 'Ub'U\WUXYa ]\Wh\Ug\_z'ghYU']b[ 'cf'U\\ello i ]f]b[ Ubch\ Yf'dYfgcb'g' U\WUXYa ]\Wk cf\_'Ub\X'\\ello dm]b[ ']hz'c\ZYf]b[ 'hc'\\ello a d`YhY'Ubch\ Yf'dYfgcb'g' k cf\_'cf'gYY\_]b[ d\una Ybh\Zcf'\\ello a d`Yh\beta d`

±bUddfcdf]UhY`W]hUh]cb.`7]h]b[ˈgci fW/gˈk \]WX`\Uj Y`bchVYYb`fYUXžk]h\ci hUW\_bck`YX[]b[ˈh\Y`″gYWcbXUfm″gci fW/Zfca k \]WX`\_bck`YX[Y`cZh\Ya`\Ug'VYYb`cVhU]bYX"

8 i d`]\WUh]cb`ff`gY`Zld`U[]\Uf]ga "Ł`gi Va]\h]b[`mci f`ck b`k cf\_ž]b`k \c`Y`cf`]b`dUfhžk \YfY`]h`\Ug`dfYj]ci g`m VYYb`dfYdUfYX`cf`gi Va]\hYX`Zcf`Ubch\Yf`UqqYqqa Ybhcf\Wci fgY`UhI\_BGK\_`cf`Ubch\Yf`i b]\Yfq]\m"

7 cffYWhfYZYfYbWb[dfUWhWyg.

• VYHYfa UbU[Ymcifh]a Y

<u> </u>	<u> </u>	

		<b>@YWi fY'h]hY</b> . 'H\Y'U[Y'cZk UfcfXg.'Zfca 'A Uf]i g'hc 7 UYgUf
K YY_`+.`%*`5df]`!`&&	Hi hcf]U`	Hi hcf]U`WcbhYbh; U]i g`A Uf]i g
5df]`		FYei]fYX`fYUX]b[.`GY`YWf]cbg`cZD`iHufW\ž`>[XWaX ?Sd[ge/GU``ighž`FZW <gygdfz[`wisd< th=""></gygdfz[`wisd<>
	5ggYgga Ybh	B6. H\]g']g'h\Y'`Ughh hcf]U`'Zcf'k\]W\'mci 'WUb'gi Va]h U'h hcf]U`'YggUm
	@YWhifY	Hcd]W'@UhYFYdiV`]W
		<b>@YWhifY</b> 'h <b>jhY</b> .'H\Y'YbX'cZh\Y'FYdiV`]W
K_YY_`; .`&' `5df]``!`&- 5df]`	Hi hcf]U`	Hi hcf]U``WcbhYbh`DcfhfU]hifY`]b'h\Y`FYdiV`]W
		F Yei ]fYX fYUX]b[ . Ga ]h\ fl% , %Ł
	@YWhifY	

		3`U[Wf: [efack	
	@YWhifY	Hcd]W'HfUbg]hjcb]b[ 'Ya d]fY	
		<b>@YWi fY'I]hY</b> ."H\Y'U[Y'cZh\Y'a]`]IUfm'H\Y'DYfg]Ub K Ufg	
	5ggYgga Ybh	Ei]n'&']g'hc'VY'Wcad'YhYX']b'kYY_''&	
K YY'% . &, 'A Um! '' >i bY	Hi htf]U`	Hi hcf]U`WcbhYbh'H\Y'XYUh\'cZ; cfX]Ub'=UbX'h\Y WUdhi fY'cZJ U`Yf]Ub	
		F Yei ]fYX fYUX]b[. 8cX[Ycb7@]Yi fl%-(ŁźgY`YW]cbg	
	@YVVni fY	Hcd]W'@UhY'Ya d]fY	
		<b>@YWi fY'ijhY</b> ."H\Y'YbX."H\Y'Xca ]bUhY'UbX'`UhY Ubhjei ]hm	
	5ggYgga Ybh	H\Y`a U`cf`YggUm]g`Xi Y`cb`h\Y`%ghcZ>i bY`Uh'%*\$\$"	

## Fygci fWyg

## DfYgWf]VYX F Ygci fWYg

 $H\YfY`UfY`bc`dfYgWf]VYX`fYgci~fWYg`ff\ci~[~\gYY`fYWca~a~YbXYX`fYgci~fWYg`VY`ck~\ell'']$ 

## FYWca a YbXYX FYgci fWYg

A ccX`Y`dfcj ]XYg`U`bi a VYf`cZYggYbh]U``fYgci fWrg`fdf]a Ufmgci fWrg/fY`]UV`Y`cb`]bY`YbWhWcdYX]UgŁ"
H\Y`Wci fgY`fYWca a YbXYX`hYI hVcc\_g`UfY.`

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