

# 7ci fgY<sup>-</sup>Cj Yfj ]Yk

# GHJZ7cbHJWh8YHJ]`g

# 7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]m	@cWUhjcb	D\cbY
8 f Hcbm@Yk]g	U"X"`Yk ]g4 i bgk "YXi "Ui	d`YUgY`WcbHJWfiVm Ya U]``hc`UffUb[Y`U WJ``	b#J	

# GWXcc`7cbHJWh′±bZcfa Uh]cb

GWLcc``cZhLY`5fhg`UbX`AYX]U

Fcca " ‰ž@Yj Y`" žFcVYfhK YVghYf'6i ]`X]b[ fl %(Ł

D\cbY.'f\$&E'-',)'(,)\*

9a U]`. 'gUa 4 i bgk "YXi "Ui

K YVg]hY. k k k "Ufhg"i bgk "YXi "Ui #gUa

#### 5W\_bck `YX[ Ya YbhcZ7ci bhfm

I BGK '5ffgž8Yg][ b'UbX'5fW,]hYWi fY'? Ybg]b[ hcb'UbX'DUXX]b[ hcb'WJa di gYg'UfY'Vi ]'hcb'5Vcf][ ]bU`@UbXg"'K Y'dUmci f'fYgdYWg'hc'h\Y'6]X'][ U''UbX'; UX][ U''dYcd'Yg'k \c'UfY'h\Y'7 i ghcX]Ubg'cZh\YgY'`UbXg" K Y'UW\_bck 'YX[ Y'h\Y'5Vcf][ ]bU`'UbX'HcffYg'G'HU]h=g`UbXYf'dYcd'Ygž'h\Y': ]fgh5i ghfU`]Ubgžk \cgY'`UbXgž k ]bXg'UbX'k UhYfg'k Y'U``'bck 'g\UfYž'UbX'dUmfYgdYWhc'h\Y]f'i b]ei Y'j U'i Ygž'UbX'h\Y]f'Wcbh]bi ]b[ 'UbX YbXi f]b[ 'W'h fYg'k \]W. 'XYYdYb'UbX'Ybf]W. 'h\Y'`]ZY'cZci f'bUh]cb'UbX'Wca a i b]h]Yg"''

- 7 cffYWh]XYbh]ZWUh]cb cZh\Y dcdi `Uf`a i g]W[YbfY UbX ^ gh]ZWUh]cb cZmci f'Ubgk Yf
- 5ddfcdf]UhY XYgWf]dh]cb cZh\Y a i g]WU ghnY cZh\Y YI Ua d'Y
- $\bullet \ 9 \ | \ d`UbUh]cb`cZh\Y`\ ]ghcf]WU`!gcW]c`c[\ ]WU`!hYI h' U``g][\ b]Z]WUbWY`cZh\Y`YI Ua \ d`Y$

# 5ggYgga Ybh& 5gg][ ba Ybhg

5gg][ ba Ybhgˈk ]```]bWi XY`\_YmfYUX]b[ gžˈWcbW/fhfYj ]Yk gžˈUbXˈdfUW]WU``YI YfV]gYgž'U```cZk \]W\`UfY`]bh/bXYX

Raac gR]"

.

 $\label{eq:Karlowskin} K f] \verb| hh | b | k cf_g | ci `X `VY `gi Va | hh | X `Ug `U `dXZ Z | Y " `F YWcfX | b [ g `g | ci `X `VY `gi Va | hh | X `] b `a d' `Zcfa Uh' | b | k cf_g | ci `X `VY `gi Va | h | X `Zcfa Uh' | cf_g | cf$ 

.

 $\label{eq:continuity} D`YUgY`U`gc`dcghmcif`giVa]gg]cbg`]b`h\Y`fY`YjUbhZcfia`cb`AccX`Yž]b`cfXYf`hc`gh]ai`UhY`WcbghfiWljYUbX`Wf]h]WU`X]gW gg]cb`cZh\Ya`Uacb[ghh\Y`WUgg"$ 

 $\label{eq:higher_high$ 

#### DYUgYUXYfYhchXYZc``ck]b['[i]XY`]bYg.

- Mci f'hcd]WcZfYgYUfW.'g\ci `X'VY'VUgYX'cb'cbY'cZh\Y'UfYUg'Wcj YfYX']b'h\Y'Wci fgY'Vi hi g]b[X]ZZYfYbh'Ufh]ghg'UbX'a i g]WU``YI Ua d`Yg'Zfca 'h\cgY']bWi XYX']b'h\Y'`YWh fYg'''Hcd]Wg'cf'WcbWldhg VYmcbX'h\cgY'Wcj YfYX']b'h\Y'Wci fgY'a UmVY'i gYX'k]h\rh\Y'Uddfcj U``cZh\Y'Wci fgY'Wcbj Ybcf''
- #b`Wbgi`HJhJcb`k]h\`h\Y`WbifgY`WbjYbcfžYUW\`[fcid`k]``XYWJXY`cb`h\Y`HJg\_g`fYei]fYX`Zcf`h\Y fYgYUfW\`UbX`h\Y`]bX]j]XiU``Wbhf]VihJcbg`cZYUW\`a Ya VYf`cZh\Y`[fcid"`H\YgY`HJg\_g`UbX Wbhf]VihJcbg`g\ci`X`VY`WYUf`miXcW`a YbhYX`]b`mcif``cifbU``UbX`k]```VY`igYX`]b`h\Y`UggYgga Ybh dfcWfgg"
- Mci g\ci X h\cfci [\mfYgYUfW\mci f hcd]Wi g]b[ Vch\ df]a UfmUbX gYWcbXUfmgci fWYg"
- Mci f'dfc YWig\ci `X`\Uj Y'U'WYUf'mXYZ|bYX'fYgYUfW\ 'ei Ygr]cb'cf'dfcV'Ya "': cf']bghUbWfžmci 'a ][\h XYW]XY'hc'gY`YWih\Y'[YbYfU`hcd]WcZ\YUj ma YhU`a i g]WVi hZcW g'cb'h\Y']ggi Y'cZ[YbXYfž']b dUfr]W\'Ufz'U'gdYW]ZWZ\a U'Y'\YUj ma YhU`VUbXžk\]W\']g'bcfa U``mUhmd]WU``cZh\Y'[YbfY"'H\Y VUW\_[fci bX'cZh\Y'VUbX'a Ya VYfg'Wci `X'VY']bj Ygr][UhYX'UbX'h\Y'fUh]cbU'Y'VY\]bX'h\Y]f'Yblfm]bhc k\Uh]g'bcfa U``mUa U'Y'a i g]WU``Xca U]bžYI Ua ]bYX"
- Mci f'dfc YWig\ci `X'fYZYf'hc'Uh`YUghikk c'gdYWJZJWa i g]WU``Yl Ua d`Yg'hc']``i ghfUhY'mci f'Uf[i a Ybhg UbX'WcbWi g]cbg"'Dfcj ]XY'cb`]bY'`]b\_g'hc'mci f'Yl Ua d`Yg"

# FYgci fWyg

#### DfYgWf]VYX F Ygci fWyg

5 ``Uf[Y'bi a VYf'cZfYgci fW/g'UfY'Uj U]`UV`Y'h\fci [\'@Y[Ubhcžcb'h\Y'A ccX`Y'g]hY''

## FYWca a YbXYX FYgci fWYg

5 ``Uf[Y'bi a VYf'cZfYgci fW/g'UfY'Uj U]`UV`Y'h\fci [\'@Y[Ubhcžcb'h\Y'A ccX`Y'g]hY''

### 7ci fgY 9j U'i Uhjcb UbX 8Yj Y'cda Ybh

 $H\g``Wci fgY'k ]```VY'Yj U`i UhYX'h\fci [\a m9l dYf]YbW'ei Ygh]cbbU]fY''`E i U`]hUhJj Y']bZcfa UhJcb'k ]```VY'i gYX ]b'X]gW gg]cb'k ]]h\'UWUXYa ]WWc```YU[ i Ygž'hc'Wcbg]XYf'UbmUddfcdf]UhY'W\Ub[ Yg'hc'WcbhYbhz'XY`]j Yfmz'UbX UggYgga Ybh''H\]g'Wci fgY'\Ug'bchVYYb'hUi [ \h'Zcf'gYj YfU`'mYUfg''$ 

# Gi Va ]gg]cb cZ5ggYgga YbhHUg\_g

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

Image: Ybwci bhYf'U'dfcV'Ya k \Yb'UhYa dhJb['hc'gi Va ]hmci f'Ugg][ ba Ybht\fci [\'Hi fb]hJbž'd'YUgY

HY'Yd\cbY'9| hYfbU'`Gi ddcfhcb'-', ) '' ' ' %cf'Ya U]`'h\Ya 'cb'Y! hYfbU'hY'hgi ddcfh4 i bgk "YXi "Ui '"'Gi ddcfh
\ci fg'UfY', .\$\$Ua '-'%\$.\$\$da 'cb'k YY\_XUmg'UbX'-.\$\$Ua '-').\$\$da 'cb'k YY\_YbXg'fl \*) 'XUmg'U'mYUfŁ"'=Imci
UfY'i bUV'Y'hc'gi Va ]hmci f'Ugg][ ba YbhXi Y'hc'U'ZJi 'hk ]h\'Hi fb]hJb'mci 'a UmUdd'mZcf'Ub'Y! hYbg]cbž'Vi hmci
a i ghfYhJ]b'mci f'hJW\_Yhbi a VYf'Zfca '9! hYfbU'`Gi ddcfhfU'cb['k]h\'Ubmch\Yf'fY'Yj UbhXcW a YbhgŁ'hc
]bWi XY'Ug'Yj ]XYbW'hc'gi ddcfhmci f'Y! hYbg]cb'Udd']WUhJcb"'=Imci 'Ya U]`'9! hYfbU'`Gi ddcfhmci 'k]``
Ui hca UhJWJ'`mfYWY]j Y'U'hJW\_Yhbi a VYfž'Vi h]Zmci 'hY'Yd\cbY'mci 'k]``bYYX'hc'gdYWJZJWJ'`mUg\_'Zcf'cbY"
Hi fb]hJb'U'gc'dfcj ]XYg'i dXUhYg'cb'h\Y]f'gmghYa 'ghUh' g'cb'Hk]hYf"

; YbYfU``mž'UggYgga YbhiHug\_g'a i gh'VY'gi Va ]hhYX'Y`YWfcb]WJ``mj ]U'Y]h\Yf'Hi fb]h]b'cf'U'A ccX`Y Ugg][ ba Ybh'' = D']bgHJbWYg'k \YfY'h\]g']g'bchdcgg]V'Yž']hk ]``VY'gHJhYX'cb'mci f'Wci fgY'g'A ccX`Y'g]hY'k ]h\

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

D`U[]Uf]ga i]gii g]b[ih\Yik cfXgicfi]XYUgicZch\YfgiUbXidfYgYbh]b[ih\Ya iUgimci fick b"i±i\WbihU\_Yia Ubm Zcfa gžZfca iXYi]VYfUhYiW\YUh]b[ihciU\W]XYbhU`m\Wcdm]b[iZfca iUigci f\Wik ]h\ci hiU\w\_bck iYX[Ya Ybh'

I BGK '[fci dg'd'U[]Uf]ga ']bhc'h\Y'Zc``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 hcf']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']bWi XYg'Wcdm]b[ 'a UhYf]U`gž']XYUg'cf'WcbW'dhg'Zfca 'U'Vcc\_ž'Ufh]WYž fYdcfhcf'ch\Yf'k f]hhYb XcW a Ybhz'dfYgYbhUh]cbž'Wca dcg]h]cbž'Uffk cf\_ž'XYg][ bž'XfUk ]b[ ž'W]fWi ]hfmž'Wca di hYf dfc[ fUa 'cf'gcZk UfYž'k YVg]hYž']bhYfbYhz'ch\Yf'Y`YWfcb]WfYgci fW'z'cf'Ubch\Yf'dYfgcbfg'Ugg][ ba Ybhk ]h\ci h Uddfcdf]UhY'UW\_bck 'YX[ Ya Ybh''

**₺Uddfcdf]UhY** 'dUfUd\fUg]b[.'