

MDIA2000

5b]a Uhjb[A YX]U

HYfa 'Hk c''##'&\$&%

7ci fgY'Cj Yfj]Yk

GHJZZ7cbHJWh8YHJ]`g

7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`] m	@cWUh]cb	D\cbY
5`mggU'Fch\kY``	Ü	J]U'Ya U]` Uddc]bha Ybh'U"fch\ k Y``4 i bgk "YXi "Ui	' %% '@Yj Y`'' ž G]f:FcVYfh KYVgHYf 6i]`X]b[ž IBGK	D`YUgY'Ya U]`

GWkcc~7cbhJWh~abZcfa Uh]cb

GWXcc`cZh\Y'5fhg'UbX'AYX]U

Fcca ' %&ž@Yj Y`' žFcVYfhK YVghYf6i]X]b[fl %(Ł

D\cbY. 'f\$&Ł'-',) '(,) *

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

K YVq]hY. k k k "Ufhq"i bak "YXi "Ui #qUa

 $\label{eq:hamiltonian} $$HY'GWCC``cZhY'5ftg'UbX'AYX]U'kci`X``]_Y'tc'FYgdYWM\cong \cong m5W_bck`YX[Y'h\Y'HfUX]tjcbU``7igtcX]Ubg\cong h\Y'6YXY[U'`fPYbg]b[hcb'WJadig\cong ix', UX][U'`fP]hmUbX'5fti/'8Yg][b'7UadigYg\cong iybUx't\Y'B[ibbUkU`dYcd'Y'fbigffU`]Ub'8YZYbW': cf\w'5\\\XYami]b'7Ub\YffU\cozh\Y'`UbXg'k\YfY'YUW\\WJadig'cZIBGK']g`c\\WJhYX''$

7ci fgY 8YHJ] g

7 fYX]hDc]bhg**

Gi a a UfmcZh\Y'7ci fgY

5b]a Uhjcb']g'U'i b]j YfgU'ij]gi U`iZcfa ik]h\`U'f]W\`\]ghcfm'UbX'a i `h]d`Y'Udd`]WUhjcbg']b'WcbhYa dcfUfm`]ZYž Zfca 'h\Y'WjbYa U'hc'ZjbY'Ufhgž'UXj Yfh]g]b['UbX'VYmcbX''' \delta h\]g'\UbXglcb'Wci fgY'mci ik]``VY'YbWci fU[YX'hc WfYUh]j Y`mYl d`cfY'U'VfcUX'fUb[Y'cZ&8'Ub]a Uhjcb'hcc`gž'[U]b]b['U'Zci bXUhjcb']b'ghfU][\h'U\YUXž'_YmZfUa Y UbX'ghcd!a chjcb'Ub]a Uhjcb'hYW\b]ei Yg'i g]b[']bXi ghfmghUbXUfX'Wca di hYf!VUgYX'gcZhk UfY'UbX'Yei]da Ybh' K]h\`Ub'Ya d\Ug]g'cb'hYW\b]WU`i bXYfghUbX]b['UbX'Z bXUa YbhU`'WcbWrdhg'cZj]gi U''ghcfmhY``]b[ž'h\]g Wci fgY'k]``Yei]d'mci ik]h\'h\YW\bZ]XYbWrUbX']bXYdYbXYbWr'hc'XYj Y'cd'mci f'ck b'Ub]a Uhjcb'dfUWf]W/k]h\]b'U'XmbUa]WUbX'Yj c`j]b['hYW\bc`c[]WU``UbXgWUdY''

7 ci fgY @YUfb]b[Ci hWca Yg

%" 8Ya cbghfUhY'_bck`YX[Y'cZh\Y'df]bW]d`Yg'cZUb]a Uh]cb'UbX'dfcXi Wh]cb'hYW\b]ei Yg" &"

		hYWXb]ei Yg:/ 'a UhYf]U`g"' K cf_]b['k]h\ 'd`Ugh]W]bY`fWUma Uh]cbŁ/ 'a]I YX 'a YX]U f[fUbi `UfŁ
K YY_'(.~&%'>i bY'!~&) >i bY	C b`]bY 5 W]j]hm	&8 '5b]a Urjcb '±bgd]fUrjcb'/ '±bZi YbW' 5b]a Urjcb '7 cbhYa dcfUfm
	Gh X]c	5 dfuWgWU`YI d`cfUrjcb'cZUb]a Urjcb'rcc`gž hYW\b]ei Yg'/ 'a UrYf]U`g"' 7 fYUrjb['U'W Hci rig]`\ci YrhY'di ddYr'
K YY_').'&, '>i bY'!'&'>i `n	n Cb`]bY`5WNjj]hm GhX]c	&8 '5b]a Ur]cb7 'Gci bX

FYgci fWyg

DfYgWf]VYX F Ygci fWyg

5 'fY`]UV`Y`UbX`dfcZYgg]cbU``\UfX!Xf]j Y`]g`YggYbh]U``hc`Ybgi fY`h\UhU```dfcXi Wf]cb`k cf_`]g`VUW_YX`i d`UbX gUZY`mghcfYX`Zcf`h\]g`Wci fgY`fUbX`U```dfcXi Wf]cb`Wci fgYgŁ`UbX`Zcf`Z hi fY`i gY`]b`mci f`A YX]U`DfcXi Wf]cb DcfhZc`]c"`Ghi XYbhg`a UmVY`Ug_YX`hc`Xck b`cUX`gdYW]Z]WZfYY`cf`]bYI dYbg]j Y`Uddg#gcZhk UfY`UbX`[Uh\Yf`cf di fW\UgY`]bYI dYbg]j Y`fYgci fWrg`UbX`Wcbgi a UV`Yg"`\=\bY\WrggUfmz`XYhU]`g`k]```VY`dfcj]XYX`]b`WUgg"

D'YUgY fYZYf hc a X]U&\$\$\$ 5b]a Uhjb[A YX]U @A G Zcf i d hc XUhY fYgci fWY fYWca a YbXUhjcbg"

FYWca a YbXYX FYgci fW/g

D'YUqY'fYZYf'hc'h\Y'a X]U&\$\$\$'A ccX'Y'q]hY'Zcf'i d'hc'XUhY'fYqci fWY'fYWca a YbXUh]cbg"'

IgYZ\`fYZYfYbWY`Vcc_

H]hY. 'H\Y'5b]a Uhcffg`Gifj]jU`'?]h5'A UbiU`cZA Yh\cXgžDf]bWd`Yg`UbX': cfai`Ug`Zcf'7`Ugg]WU`ž'7 ca dihYfž; Ua YgžGhcd'A chcb'UbX'=bhYfbYh5b]a Uhcfg`

5i h\cf. <u>F]W\UfX K]``]Ua g</u>

9X]h]cb. Bi a VYf. &

Di V`]g\YX. %gh>Ubi Ufm&\$\$-

 $\pm 6B.'-+, \$, *)(+, -+,$

7ci fgY 9j U`i Uh]cb UbX 8Yj Y`cda Ybh

5 Wea V]bUh]cb cZh,Y Zc ck]b['UddfcUW,Yg'k]``VY i gYX'rc [Uh,Yf'ZYXVUW_'UVci hh,Y 'Wci fgY"' I BGK A m9I dYf]YbW Wci fgY 'UbX'hYUW,]b['Yj U'i Uh]cb 'UbX']a dfcj Ya YbhdfcW gg" 5bYWch' '9j U'i Uh]cb zk \YfY ghi XYbhg Zfca 'h]a Y 'rc 'h]a Y Xi f]b['h,Y 'gYa YghYf'UfY Yb[U[YX']b]bZcfa U'X]gW gg]cbg'UVci hh,Y 'Wci fgY" C VgYfj Uh]cbU' '9j U'i Uh]cb k \YfY 'h,Y 'YWi fYf'fWcbj YbYf'cf'hi bfL'fY[i 'Uf'mcVgYfj Yg'h,Y 'YZYWl] YbYgg cZ WUggYg 'UbX' YWi fY 'UbX'a cX]ZYg'h,Y 'Wci fgY 'WcbhYbhUbX'XY'] Yfm]b 'fYgdcbgY'hc 'h,cgY' cVgYfj Uh]cbg" DUghYj U'i Uh]cb Z[bX]b[g`\Uj Y VYYb'UWfX'i dcb ']b'h,Y 'Zc `ck]b['k Umg"' =k Ug']XYbhJZYX'h,fci [\ 'ZYYXVUW_hUhghi XYbhg VYbYZ]h'X'k \Yb'h,Y 'Wci fgY 'UggYgga YbhHUg_g'k YfY'U'][bYX'k]h, 'bYYXg'cZh,Y 'W]Ybhdfc YWh UbX'W]Ybhdfc YWh' '=k Ug']XYbhJZYX'|b'g' '=b 'fYgdcbgY'hc 'h,UhhXYYXVUW_U'``U``UggYgga YbhHUg_g'fy X'bhg'hc '\Uj Y'a cfY']b 'WUgg ha Y'hc 'k cf_'cb' [fci d'dfc YWg'UbX']bX]j]Xi U``dfc YWg"' =b 'fYgdcbgY'hc 'h,UhZYYXVUW_h\DhXYYXZUW_h\DhXYYXVUW_h\DhXYYXYUW_h\DhXYYXVUW_h\DhXYYXVUW_h\DhXYYXYUW_h\DhXYYXVUW_h\DhXYYXYUW_h\DhXYYXYUW_h\DhXYYXVUW_h\DhXYYXYUMY '\DXYYDhYYYYYYB' ID' YYYYB'YYYYB' ID' YYYYB' ID' YYYYB' ID' Y

Gi Va]gg]cb cZ5ggYgga YbhHUg_g Hi fb]h]b Gi Va]gg]cb

-Zmci 'YbWci bhYf'U'dfcV`Ya 'k \Yb'UhhYa dh]b['hc'gi Va]hmci f'Ugg][ba Ybhh\fci [\'Hi fb]h]bž'd`YUgY hY`Yd\cbY'9I hYfbU``Gi ddcfhcb'-',)'''' %cf'Ya U]`'h\Ya 'cb'YI hYfbU`hY`hgi ddcfh4 i bgk "YXi "Ui '"'Gi ddcfh

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"`±hWJb`hU_Y`a Ubm Zcfa gžZfca `XY`]VYfUhY`W\YUh]b['hc`UWW]XYbhJ``mWcdm]b['Zfca `U`gci fWY`k]h\ci hUW_bck `YX[Ya Ybh'

IBGK [fcidg'd'U[]Uf]ga]bhc'h\Y'Zc``ck]b['WUhY[cf]Yg.

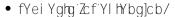
 $7 \text{ cdm}b[...i g]b[...h\Y.gUa Y.cf.j Yfmig]a] \Uf'k cfXg'hc'h\Y.cf][]bU''hYl h'cf']XYU'k]h\ci h'U\V_bck `YX[]b[...h\Y.cf][]bU''hYl h'cf']XYU'k]h'cf']$

- i bXYfgfUbX mci f'f][\hg'UbX'fYgdcbg]V]`]hJYg'Ug'U'gh XYbhUhl BGK
- VY`Uk UfY`cZd`U[]Uf]ga ž`Wcdmf][\hz'l BGK `Gh XYbh7cXY`cZ7cbXi WhUbX`5VWWdhUV`Y`l gY`cZ I BGK `=\forall H`F Ygci f\W\g`Dc`]\m\m
- VY 'Uk UfY 'cZh\Y 'ghUbXUfXg 'cZVY\Uj]ci f'Yl dYWYX 'cZYj YfmcbY ']b 'h\Y 'l BGK 'Wca a i b]hm
- `cWUHY 'gYfj]WYg'UbX ']bZcfa UH]cb'UVci hI BGK 'UbX'I BGK '@]VfUfm

Gca Y'cZh\YgY'UfYUg'k]``VY'ZJa]`]Uf'hc'mci ž'ch\Yfg'k]``VY'bYk"'; U]b]b['U'gc`]X'i bXYfgHJbX]b['cZU``h\YfY`UhYX'UgdYWng'cZ9@+69'k]``\Y`d'mci 'a U_Y'h\Y'a cghicZmci f'ghi X]Yg'UhI BGK "'\\hd.##qi VYWfi |XYg"`]VfUfm'i bqk "YXi "Ui #\`]qY#JVci hY`]qY

5 WUXYa]W + DZcfa Uhjcb

: cf'YggYbhJU`ghi XYbh']bZcfa UhJcb'fY`UhJb['hc.



- fYei Yghg Zcf Yl hYbg]cb/`UhY gi Va]gg]cbg [i]XY`]bYg/
- fYj]Yk 'cZa Uf_g/ NBGK '<YU'h\ 'UbX'GUZYhm'dc`]W]Yg/