

Tutorial for the *parcel* package

```
In [1]: # This is a tutorial to demonstrate use of the *parcel* package,  
# which maps the boundaries of properties from survey descriptions.  
#  
# It starts from deeds as pdfs, and parses them for numerical information.  
#  
# The package is especially designed to deal with 19th-century and other old  
# deeds, since old property descriptions are often repeated in recent deeds,  
# and historical boundaries can be important for property issues.
```

```
In [2]: import os  
import sys  
  
#os.listdir()  
#sys.path()
```

```
In [3]: os.chdir("..")  
import parcel  
import pytesseract  
import pytesseract as tess  
import pytesseract as tesseract  
import cProfile  
  
path = 'C:\\\\Users\\\\Matt F\\\\AppData\\\\Local\\\\Programs\\\\Python\\\\Python310\\\\'  
sys.path.append(path + 'Scripts')  
sys.path.append(path + 'site-packages')  
sys.path.append(path + '\\lib\\site-packages')  
print('Current directory:', os.getcwd())  
  
tesseract_location = 'C:\\\\Program Files\\\\Tesseract-OCR\\\\tesseract.exe'  
pytesseract.pytesseract.tesseract_cmd = tesseract_location
```

Current directory: C:\Users\Matt F\Dropbox\parcel package

Example from 1974

```
In [5]: ShultisA = parcel.pdf_to_text("parcel/sample deed.pdf", "shultisa")  
# This deed has nine parcels in it.  
# In this tutorial, we'll plot five of them, in this order:  
# parcel VII, with a short description,  
# parcel VIII, with a long modern description,  
# parcel I, with an incomplete and inconsistent description,  
# parcel II, with another short description,  
# parcel III, with an incomplete description.
```

```
In [6]: desc7 = parcel.split_deed(ShultisA, "PARCEL VII", "Parcels")  
desc7  
# Here is the description of parcel VII, from p. 4 of the deed.
```

```
Out[6]: 'PARCEL VII ALL THAT CERTAIN TRACT OR PARCEL OF LAND situate, lying | and being in t  
he Town of Shandaken, in the County of Ulster and State of New York and is a part of  
Lot Number 8 in division 2 Great Lot 7 Harden= | burgh Patent and is bounded as follo  
ws, viz: BEGINNING at a heap of stones near a beech tree against the southeast side  
of the Wittenburgh Mountain in the Division line between Divisions two and three and  
a corner of lots number 8 and 9 and runs thence North 51° 15! West 75 chains, then So  
uth 85° East 90 chains to a heap of stones a corner i of Lemuel Boice formerly Henry  
Every, and thence South 35° W 54 chains and } 60 links to the place of beginning. Con  
taining 200 acres more or less. - '
```

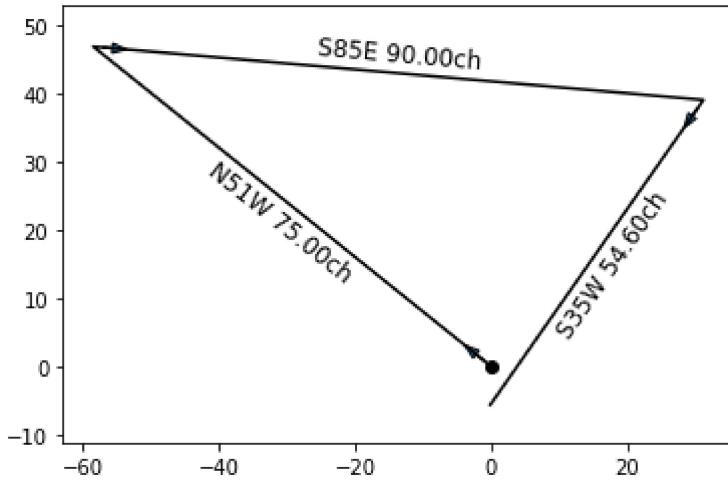
```
In [7]: parcel7 = parcel.Parcel(desc7)  
parcel7.Test()  
# We run a test of the parser, and see three defined courses.  
# Each course has seven parts, separated by vertical bars (/)
```

```
Out[7]: '['[0]: ALL THAT CERTAIN TRACT OR PARCEL OF LAND situate, lying and being in the Town  
of Shandaken, in the County of Ulster and State of New York and is a part of Lot Numb  
er 8 in division 2 Great Lot 7 Harden= burgh Patent and is bounded as follows, viz: B  
EGINNING at a heap of stones near a beech tree against the southeast side of the Wit  
tenburgh Mountain in the Division line between Divisions two and three and a corner of  
lots number 8 and 9 and runs then | North | 51 degrees 15! | West | 75 | chains, | ',  
'[1]: then | South | 85 degrees | East | 90 | chains | to a heap of stones a corner  
i of Lemuel Boice formerly Henry Every, and',  
'[2]: then | South | 35 degrees | West | 54 chains and } 60 | links | to the place o  
f']
```

```
In [8]: # The last course has a badly-parsed length.  
# So we retranscribe, removing the incorrect punctuation.  
bads = ["}"]  
goods = [""]  
retranscriptions = [bads, goods]  
  
parcel7 = parcel.Parcel(desc7, retranscriptions = retranscriptions)  
parcel7.Test()
```

```
Out[8]: '['[0]: ALL THAT CERTAIN TRACT OR PARCEL OF LAND situate, lying and being in the Town  
of Shandaken, in the County of Ulster and State of New York and is a part of Lot Numb  
er 8 in division 2 Great Lot 7 Harden= burgh Patent and is bounded as follows, viz: B  
EGINNING at a heap of stones near a beech tree against the southeast side of the Wit  
tenburgh Mountain in the Division line between Divisions two and three and a corner of  
lots number 8 and 9 and runs then | North | 51 degrees 15! | West | 75 | chains, | ',  
'[1]: then | South | 85 degrees | East | 90 | chains | to a heap of stones a corner  
i of Lemuel Boice formerly Henry Every, and',  
'[2]: then | South | 35 degrees | West | 54.60 | chains | to the place of']
```

```
In [9]: parcel7.Report("long")  
# A report with a graph shows that parcel VII's three described courses enclose  
# more than the stated area, and do not come back to the beginning exactly,  
# but they are at least close.  
# The long-form report also lists all the substitutions made before plotting.  
# One substitutions was what we input, and the others were automated.
```



```
Out[9]: [{"distances (x,y,diagonal)": [-0.151, -5.625, 5.627],
  'areas (calc,stated,diff)': [195.976, 200.0, -4.024],
  'warnings': ['', '', ''}],
None,
["unbreaking '| ' to '' (2 times)",
 "truncating 'PARCEL VII' to ''",
 "truncating 'Containing 200 acres more or less. -' to ''",
 "retranscribing ' }' to ''",
 "retranscribing 'southe' to 'south''",
 "retranscribing 'thenc' to 'then' (2 times)",
 "retranscribing 'thene' to 'then' (2 times)",
 "retranscribing 'tten' to 'then''",
 "normalizing '35°' to '35 degrees''",
 "normalizing '51°' to '51 degrees''",
 "normalizing '85°' to '85 degrees''",
 "normalizing 'degrees W ' to 'degrees West ''",
 "normalizing ' chains and 60 links' to '.60 chains'"]]
```

```
In [10]: # We go on to parcel VIII
# Parcel VIII is so long that we start by only looking at the beginning.
desc8 = parcel.split_deed(ShultisA, "ALSO ALL THAT", "The right")
parcel8 = parcel.Parcel(desc8)
parcel8.Test()[0]
```

```
Out[10]: '[0]: ALL THAT CERTAIN PIECE, PARCEL OR TRACT OF LAND, situate lying and being at West Shokan in the Town of Olive, County of Ulster and State of New York, being bounded and described as follows: BEGINNING at a bitternut tree standing at the intersection of stone-walls marking the division of lands of the parties of the first part, Robert and Kate Larsen on the east and lands of Francis Every on the west and runs in then along lands of Francis Every and along a stonewall the following three (3) courses and distances, North 1 degree 26 minutes 00 seconds East in 1380 rods 377 . a. nang , : m w bir80 ee 578 634.70 feet to a point marked by an iron rod set in said wall, North 1 degree 50 minutes 10 seconds East 193.86 feet to a point in said wall, | North | 4 degrees 57 minutes 10 seconds | East | 207.64 | feet | to a point marked by an iron rod set at the end of said wall,'
```

```
In [11]: # What is parsed as the course from the beginning actually has multiple
# courses, because this deed uses a comma-separated list of courses,
# rather than using a separator like "then" or "thence" as is usual.
# So we normalize, inserting "then"'s for clarity, and removing any extras.

bads = ["South", "North", "then, then"]
goods = ["then South", "then North", "then"]

normalizations = [bads, goods]
```

```
parcel8 = parcel.Parcel(desc8, normalizations = normalizations)
parcel8.Test()[10:27]
```

Out[11]: '['[10]: Then South 63 degrees 56 minutes 00 seconds West 62.22 feet to a large red oak tree marked; | South | 58 degrees 06 minutes 00 seconds | West | 162.35 | feet | to a point,',
'[11]: Then | South | 52 degrees 20 minutes 40 seconds | West | 131.47 | feet | to a 12 inch maple tree marked,',
'[12]: Then | North | 47 degrees 38 minutes 50 seconds | West | 958.06 | feet | to a point marked by an iron rod driven in the ground;',
'[13]: then along othen lands of the party of the second party, (Nelson Shultis) | North | 50 degrees 11 minutes 10 seconds | West | 1703.91 | feet | to a point marked by stone get on erid in a pile of stones ona rock ledge;',
'[14]: then still along lands of NelsonShultis | North | 33 degrees 55 minutes 00 seconds | East | 1254.62 | feet | passing over an iron rod set ina pile of stones to a point in the center of the Withenceg Creek;',
'[15]: then down _ and along the center of said Withenceg Creek the following twest-eight (28) 'courses and déstances, . | South | 41 degrees 04 minutes 40 seconds | East | 96.02 | feet- | to a point,',
'[16]: Then | South | 15 degrees 28 minutes 50 seconds | East | 350.10 | feet | to a point,',
'[17]: Then South 49 degrees 42 minutes 10 seconds East 68.73 feet to a point, South 86 degrees 29 minutes 50 seconds East 61.05 feet to a point, South 52 degrees 08 minutes 50 seconds East 794.48 feet to a point, South 33 degrees 33 minutes 30 seconds East 223.63 feet to a point, South 48 degrees 06 minutes 20 seconds East 109.92 feet to a 'point, | 'South | 75 degrees 43 minutes 10 seconds | East | 97.91 | feet | to a point,',
'[18]: Then | South | 49 degrees 48 minutes 40 seconds | East | 106.66 | feet | to a point,',
'[19]: Then | South | 47 degrees 37 minutes 20 seconds | East | 163.09 | feet | to a point,',
'[20]: Then | South | 68 degrees 30 minutes 40 seconds | East | 119.82 | feet: | to a point,',
'[21]: Then South 61 degrees 18 minutes 10 seconds East 337.46 feet to a point, South 52 degrees 16 minutes 20 seconds East 246.60 feet to a point, South 60 degrees 09 minutes 40 seconds East 178.99 feet to a point, South 81 degrees 15 minutes 40 seconds East 88.67 feet to a point, North 62 degrees 35 minutes 10 seconds East 136.77 feet to a point, South 59 degrees 26 minutes 10 seconds East 174.02 feet to a point, South 22 degrees 14 minutes 40 seconds East 186.39 feet to a point, South 62 degrees 30 minutes 00 geconds East 71.81 feet to a point, North 78 degrees 26 minutes 40 seconds East 132.41 feet to a point, South 66 degrees 44 minutes 20 seconds East 126.67 feet to a point, South 48 degrees 41 minutes 30 seconds East 180.04 feet to a point, South 23 degrees 52 minutes 50 seconds East 144.13 feet to a point, South 47 degrees 22 minutes 10 seconds East 118.15 feet to a point, North 87 degrees 23 minutes 50 seconds East 210.69 feet to a point, North 72 degrees 48. minutes 00 seconds East 181.04 feet to a point, South 79'degrees 14 minutes 50 seconds East 40.74 feet to a point, | South | 6 degrees 36 minutes 30 seconds | East | 44.74 | feet | to a point,',
'[22]: | | | | | then leaving said creek and along othen lands of Robert and Kate Larsen, (parties of the first part) the following eleven (11) courses and distances,',
'[23]: Then South 37 degrees 10 minutes 30 seconds West passing over an iron rod get on line 138.73 feet to a point marked by an iron rod driven in the ground, G | South | 63 degrees 31 minutes 20 seconds | West | 160.82 | feet | to a point marked by an iron rod driven in the ground,',
'[24]: Then | South | 11 degrees 11 minutes 40 seconds | West | 102.04 | feet | to a point marked by an iron rod driven in the ground,',
'[25]: Then | South | 10 degrees 55 minutes 40 seconds | East | 29.17 | feet | to a point marked \\ by an iron rod driven in the ground,',
'[26]: Then South 27 degrees 30 minutes 50 seconds | South | 11 degrees 23 minutes 2 0 seconds | East | 35.96 | feet | to a point marked by an iron rod driven in the ground,',]

```
In [12]: # Testing more shows more items to be fixed.
# Testing and fixing repeatedly might yield these ten substitutions.
# Perhaps future versions of the package will have more built-in substitutions
# that make some or all of these unnecessary.

bads = ["", South", "", North", "then, then"]
goods = [", then South", ", then North", "then"]
# To separate the beginning course from the following courses, we convert
# some commas used as separators to "then"s, and later remove any doubles.

bads += ["; South"]
goods += ["; then South"]
# In course 10 above, there was also a semicolon used as a separator.

normalizations = [bads, goods]

bads = ["get on erid", "", "", "132.41", " G"]
goods = ["set on end", "", "", "182.41", " "]
# In course 13 above, 'get on erid' mistranscribes a description used later on.
# In course 17 above, the backwards quote before South obscures the direction.
# In courses 17 and 21 above, doubled spaces obscure the comma-separated list.
# In course 21 above, the 132.41 is a mistranscription; we would notice it in
# a plot because the parcel wouldn't come back to the beginning.
# In course 23 above, the mistranscribed G obscures the comma-separated list.

bads += ["50 seconds South 11 degrees"]
goods += ["50 seconds East 71.61 feet to a point " +
          "marked by an iron rod driven in the ground, South 11 degrees"]
# In course 26 above, a whole line of text was missing from a misplaced
# transcription, so we insert the right text here.

retranscriptions = [bads, goods]

parcel8 = parcel.Parcel(desc8,
                        retranscriptions = retranscriptions,
                        normalizations = normalizations)
parcel8.Test()
```

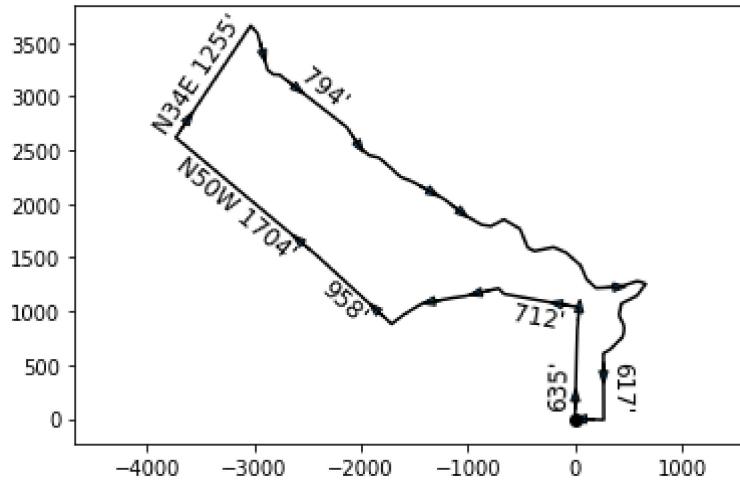
Out[12]: '['[0]: | | | | | ALL THAT CERTAIN PIECE, PARCEL OR TRACT OF LAND, situate lying and being at West Shokan in the Town of Olive, County of Ulster and State of New York, being bounded and described as follows: BEGINNING at a bitternut tree standing at the intersection of stone-walls marking the division of lands of the parties of the first part, Robert and Kate Larsen on the east and lands of Francis Every on the west and runs it then along lands of Francis Every and along a stonewall the following three (3) courses and distances,',
'[1]: Then | North | 1 degree 26 minutes 00 seconds | East | i 1380 rar 377 . a. nang , : mw bir80 ee 578 634.70 | feet | to a point marked by an iron rod set in said wall,',
'[2]: Then | North | 1 degree 50 minutes 10 seconds | East | 193.86 | feet | to a point in said wall,',
'[3]: Then | North | 4 degrees 57 minutes 10 seconds | East | 207.64 | feet | to a point marked by an iron rod set at the end of said wall,',
'[4]: then still along lands of Francis Every and partly along a stonewall and wire fence | North | 79 degrees 53 minutes 50 seconds | West | 712.16 | feet | to a point marked by an iron rod driven in the ground in range with a stonewall;',[br/>'[5]: then still along lands of Every _ | north | 44 degrees 55 minutes 21) seconds | west | 75.00 | feet | to a point marked by an iron rod driven in the ground;',[br/>'[6]: then still along lands of Every and along a stonewall | South | 76 degrees 51 minutes 20 seconds | West | 314.08 | feet | to a point in said wall;',[br/>'[7]: then still along same | South | 81 degrees 32 minutes 30 seconds | West | 131.16 | feet | to a point at the end of said wall;',[br/>'[8]: | | | | | then still along lands of Francis Every and generally along a wire fence the following five (5) courses and distances,',
'[9]: Then | South | 79 degrees 43 minutes 50 seconds | West | 269.15 | feet | to a point,',
'[10]: Then | South | 63 degrees 56 minutes 00 seconds | West | 62.22 | feet | to a large red oak tree marked;',[br/>'[11]: Then | South | 58 degrees 06 minutes 00 seconds | West | 162.35 | feet | to a point,',
'[12]: Then | South | 52 degrees 20 minutes 40 seconds | West | 131.47 | feet | to a 12 inch maple tree marked;',[br/>'[13]: Then | North | 47 degrees 38 minutes 50 seconds | West | 958.06 | feet | to a point marked by an iron rod driven in the ground;',[br/>'[14]: then along other lands of the party of the second party, (Nelson Shultis) | North | 50 degrees 11 minutes 10 seconds | West | 1703.91 | feet | to a point marked by a stone set on end in a pile of stones on a rock ledge;',[br/>'[15]: then still along lands of Nelson Shultis | North | 33 degrees 55 minutes 00 seconds | East | 1254.62 | feet | passing over an iron rod set in a pile of stones to a point in the center of the Withenceg Creek;',[br/>'[16]: then down _ and along the center of said Withenceg Creek the following twenty-eight (28) courses and distances, . | South | 41 degrees 04 minutes 40 seconds | East | 96.02 | feet- | to a point;',[br/>'[17]: Then | South | 15 degrees 28 minutes 50 seconds | East | 350.10 | feet | to a point,',
'[18]: Then | South | 49 degrees 42 minutes 10 seconds | East | 68.73 | feet | to a point,',
'[19]: Then | South | 86 degrees 29 minutes 50 seconds | East | 61.05 | feet | to a point,',
'[20]: Then | South | 52 degrees 08 minutes 50 seconds | East | 794.48 | feet | to a point,',
'[21]: Then | South | 33 degrees 33 minutes 30 seconds | East | 223.63 | feet | to a point,',
'[22]: Then | South | 48 degrees 06 minutes 20 seconds | East | 109.92 | feet | to a point,',
'[23]: Then | South | 75 degrees 43 minutes 10 seconds | East | 97.91 | feet | to a point,',
'[24]: Then | South | 49 degrees 48 minutes 40 seconds | East | 106.66 | feet | to a point,',

'[25]: Then | South | 47 degrees 37 minutes 20 seconds | East | 163.09 | feet | to a point,',
'[26]: Then | South | 68 degrees 30 minutes 40 seconds | East | 119.82 | feet: | to a point,',
'[27]: Then | South | 61 degrees 18 minutes 10 seconds | East | 337.46 | feet | to a point,',
'[28]: Then | South | 52 degrees 16 minutes 20 seconds | East | 246.60 | feet | to a point,',
'[29]: Then | South | 60 degrees 09 minutes 40 seconds | East | 178.99 | feet | to a point,',
'[30]: Then | South | 81 degrees 15 minutes 40 seconds | East | 88.67 | feet | to a point,',
'[31]: Then | North | 62 degrees 35 minutes 10 seconds | East | 136.77 | feet | to a point,',
'[32]: Then | South | 59 degrees 26 minutes 10 seconds | East | 174.02 | feet | to a point,',
'[33]: Then | South | 22 degrees 14 minutes 40 seconds | East | 186.39 | feet | to a point,',
'[34]: Then | South | 62 degrees 30 minutes 00 geconds | East | 71.81 | feet | to a point,',
'[35]: Then | North | 78 degrees 26 minutes 40 seconds | East | 182.41 | feet | to a point,',
'[36]: Then | South | 66 degrees 44 minutes 20 seconds | East | 126.67 | feet | to a point,',
'[37]: Then | South | 48 degrees 41 minutes 30 seconds | East | 180.04 | feet | to a point,',
'[38]: Then | South | 23 degrees 52 minutes 50 seconds | East | 144.13 | feet | to a point,',
'[39]: Then | South | 47 degrees 22 minutes 10 seconds | East | 118.15 | feet | to a point,',
'[40]: Then | North | 87 degrees 23 minutes 50 seconds | East | 210.69 | feet | to a point,',
'[41]: Then | North | 72 degrees 48. minutes 00 seconds | East | 181.04 | feet | to a point,',
'[42]: Then | South | 79degrees 14 minutes 50 seconds | East | 40.74 | feet | to a p oint,',
'[43]: Then | South | 66 degrees 36 minutes 30 seconds | East | 44.74 | feet | to a point,',
'[44]: | | | | | then leaving said creek and along othen lands of Robert and Kate Larsen, (parties of the first part) the following eleven (11) courses and distan ces,',
'[45]: Then | South | 37 degrees 10 minutes 30 seconds | West | passing over an iron rod get on line 138.73 | feet | to a point marked by an iron rod driven in the ground,',
'[46]: Then | South | 63 degrees 31 minutes 20 seconds | West | 160.82 | feet | to a point marked by an iron rod driven in the ground,',
'[47]: Then | South | 11 degrees 11 minutes 40 seconds | West | 102.04 | feet | to a point marked by an iron rod driven in the ground,',
'[48]: Then | South | 10 degrees 55 minutes 40 seconds | East | 29.17 | feet | to a point marked \\ by an iron rod driven in the ground,',
'[49]: Then | South | 27 degrees 30 minutes 50 seconds | East | 71.61 | feet | to a point marked by an iron rod driven in the ground,',
'[50]: Then | South | 11 degrees 23 minutes 20 seconds | East | 35.96 | feet | to a point marked by an iron rod driven in the ground,',
'[51]: Then | South | 5 degrees 45 minutes 00 seconds | West | 45.62 | feet | to a p oint, marked by an iron rod driven inthe ground,',
'[52]: Then | South | 16 degrees 23 minutes 40 seconds | West | 43.23 | feet | to a point marked i by an iron rod driven in the ground,',
'[53]: Then | South | 45 degrees 06 minutes 20 seconds | West | 156.34 | feet | to a point marked by an iron rod driven in the ground,',

'[54]: Then | South | 58 degrees 22 minutes 30 seconds | West | 77.62 | feet | to a point marked i by a ceder stake set in a stonewall;',
 '[55]: then along said stonewall | South | 0 degrees 13 minutes 50 seconds | East | 617.48 | feet | to a point marked by an iron rod set in a stonewall corner;',
 "[56]: then along another stonewall | north | 87 degrees 32 minutes 00 seconds | West | 268.70 | feet | to the point and place ' of beginning. { Containing 96.75 acres of land. ; Bearings are with reference to magnetic north of 1969 as surveyed by Robert G. Cross, Professional Land"]

In [13]: `parcel18.Report()`

```
# The report shows that after retranscription and normalization,
# this is a consistent survey: The x and y errors are within a foot.
# The calculated and stated areas are within .001 acre.
```



Out[13]: `[{'distances (x,y,diagonal)': [0.019, -0.068, 0.071],
 'areas (calc, stated, diff)': [96.751, 96.75, 0.001],
 'warnings': ['', '', ''}],
 None,
 []]`

In [14]: `# Now we return to parcel 1`

```
desc1 = parcel.split_deed(ShultisA, "PARCEL 1", "PARCEL IL")
parcel1 = parcel.Parcel(desc1)
parcel1.Test()
```

```

Out[14]: '['[0]: : ALL THAT TRACT OF LAND in said Towns of Olive and Shandaken in said County o
f Ulster, bounded and described as follows: _ BEGINNING at a heap of stones on the no
rth side of the Hanover Mountain, a corner : of formerly Moses Eckert in the line of
division 2 and 3 in said Great Lot and runs from then | North | 52 degrees | West | 1
10 | chains | to a heap of stones against the southeast side of the Withenceg Mountai
n, a corner of Lots 8 and 9 in Division 2 and 3,',

'[1]: then along lot #8 in the Division 2 | North | 35 degrees | East | | | to the
bounds of a lot surveyed for Garrison Davis and Peter Burger, now Henry Every;',

'[2]: then along the same | South | 35 degrees | East | | | to a heap of stones, : a corner of said lot;',

'[3]: then | South | 70 degrees | West | 39 | chains | to a heap of stones on the ri
dge;',

'[4]: then | South | 18 degrees | West | 51 | chains | to a heap of stones on 'the S
outh side of middle ridge; B',

'[5]: then | South | 70 degrees | East | 43 | chains | to a heap of stones on'a ledg
e of rocks, a corner ofa ; 300acre lot hereinafter described;',

'[6]: then along the same | South | 56 degrees | West | 46 | chains | to a heap of s
tones on the North side of the mountain;',

'[7]: then | South | 46 degrees | East | 56 | chains | to stones, being a beech tree
marked E.B. 1847 M.L. about 10 links from a ledge of rocks on the. south side of the
mountain;',

'[8]: then | North | 58 degrees | East | 24 | chains | to stones around a beech tre
e, a.corner of the Burgher Mill lot;',

'[9]: then along the same | South | 70 degrees | East | 15 | chains | to stone aroun
d a beech tree;',

'[10]: then | North | 62 degrees | East | 10 | chains | to the south bank of the Wit
henceg Stream, a corner of Garrison Davis;',

'[11]: then | South | 28 degrees | West | 21 | chains | to a heap of stones on a led
ge of rocks;',

'[12]: then | South | 57 degrees | East | 20 | chains, | a corner of formerly Moses
Eckert 4 aforesaid;',

'[13]: | | then along his bounds | West | 17.50 | chains | to a heap of stones on
a rock,',

'[14]: then | South | 45 degrees | West | 11 | chains | to stones on a rock;',

'[15]: then | South | 10 degrees | West | 19 | chains | 'to the place of'

```

```

In [15]: # The | | in the test indicate missing data in the description.
# So we can ask the package to infer the missing lengths in courses 1 and 2,
# and assume that "West" in course 13 means "due West".

bads   = ["East to the",           "East to a heap"]
goods  = ["East unknown1 chains to the", "East unknown2 chains to a heap"]
bads += ["bounds West"]
goods += ["bounds due West"]

parcel1 = parcel.Parcel(desc1, normalizations = [bads, goods])
parcel1.Test()

```

```

Out[15]: '['[0]: : ALL THAT TRACT OF LAND in said Towns of Olive and Shandaken in said County o
f Ulster, bounded and described as follows: _ BEGINNING at a heap of stones on the no
rth side of the Hanover Mountain, a corner : of formerly Moses Eckert in the line of
division 2 and 3 in said Great Lot and runs from then | North | 52 degrees | West | 1
10 | chains | to a heap of stones against the southeast side of the Withenceg Mountai
n, a corner of Lots 8 and 9 in Division 2 and 3,',

'[1]: then along lot #8 in the Division 2 | North | 35 degrees | East | unknown1 | c
hains | to the bounds of a lot surveyed for Garrison Davis and Peter Burger, now Henr
y Every;',

'[2]: then along the same | South | 35 degrees | East | unknown2 | chains | to a hea
p of stones, : a corner of said lot;',

'[3]: then | South | 70 degrees | West | 39 | chains | to a heap of stones on the ri
dge;',

'[4]: then | South | 18 degrees | West | 51 | chains | to a heap of stones on 'the S
outh side of middle ridge; B',

'[5]: then | South | 70 degrees | East | 43 | chains | to a heap of stones on'a ledg
e of rocks, a corner ofa ; 300acre lot hereinafter described;',

'[6]: then along the same | South | 56 degrees | West | 46 | chains | to a heap of s
tones on the North side of the mountain;',

'[7]: then | South | 46 degrees | East | 56 | chains | to stones, being a beech tree
marked E.B. 1847 M.L. about 10 links from a ledge of rocks on the. south side of the
mountain;',

'[8]: then | North | 58 degrees | East | 24 | chains | to stones around a beech tre
e, a.corner of the Burgher Mill lot;',

'[9]: then along the same | South | 70 degrees | East | 15 | chains | to stone aroun
d a beech tree;',

'[10]: then | North | 62 degrees | East | 10 | chains | to the south bank of the Wit
henceg Stream, a corner of Garrison Davis;',

'[11]: then | South | 28 degrees | West | 21 | chains | to a heap of stones on a led
ge of rocks;',

'[12]: then | South | 57 degrees | East | 20 | chains, | a corner of formerly Moses
Eckert 4 aforesaid;',

'[13]: then along his bounds | south | 90 degrees | west | 17.50 | chains | to a hea
p of stones on a rock,',

'[14]: then | South | 45 degrees | West | 11 | chains | to stones on a rock;',

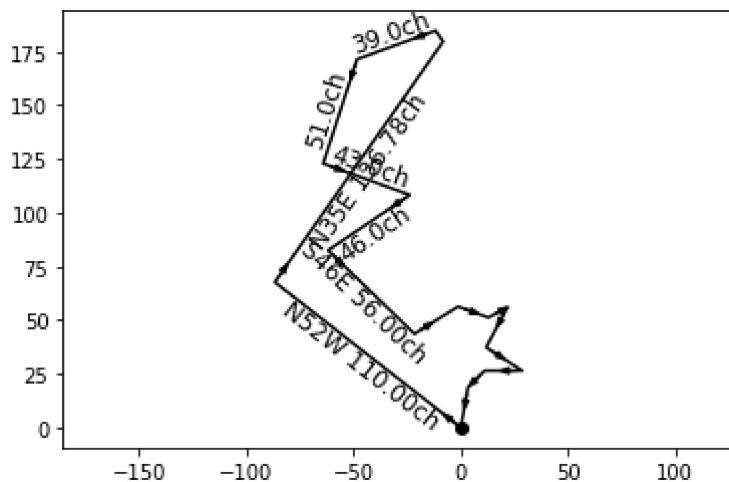
'[15]: then | South | 10 degrees | West | 19 | chains | 'to the place of'

```

```

In [16]: # This gives us a cleanly parsed description, but the report has issues.
parcel1.Report()

```



```
Out[16]: [{"distances (x,y,diagonal)": [0.0, -0.0, 0.0],  
           "areas (calc,stated,diff)": [250.95, 350.0, -99.05],  
           "warnings": ['self-intersection(1, 5)', '', 'negative side length']},  
          None,  
          ["inferring 'unknown1' to '136.781'", "inferring 'unknown2' to '-6.162'"]]
```

```
In [17]: # Interpreting the description as above led to:
```

```
# - a bad area difference,  
# - a self-intersection,  
# - and a negative inferred side length.  
# So something must be wrong in the parcel description.  
# We won't figure out a correction here.
```

```
In [18]: # The descriptions for parcels I and VII line up well on Wittenberg mountain.
```

Parcel I has such a bad shape that we leave it unlabeled in the jigsaw.

```
parcel.Jigsaw([parcel1, parcel7],
```

```
names = ["p1", "p7"],
```

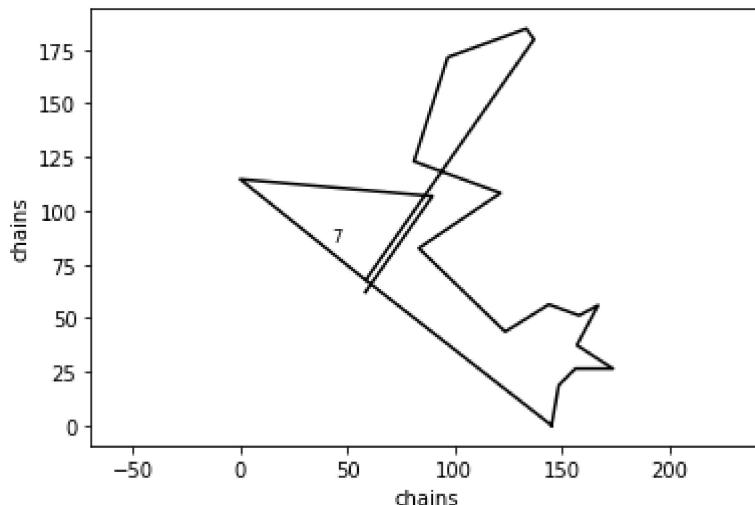
```
labels = ["", "7"],
```

```
conditions = ["p1's Withenceg is p7's Wittenburgh"]).Report()
```

p1's Withenceg is p7's Wittenburgh

"a heap of stones against the southeast side of the Withenceg Mountain, a corner of Lots 8 and 9 in Division 2 and 3,""

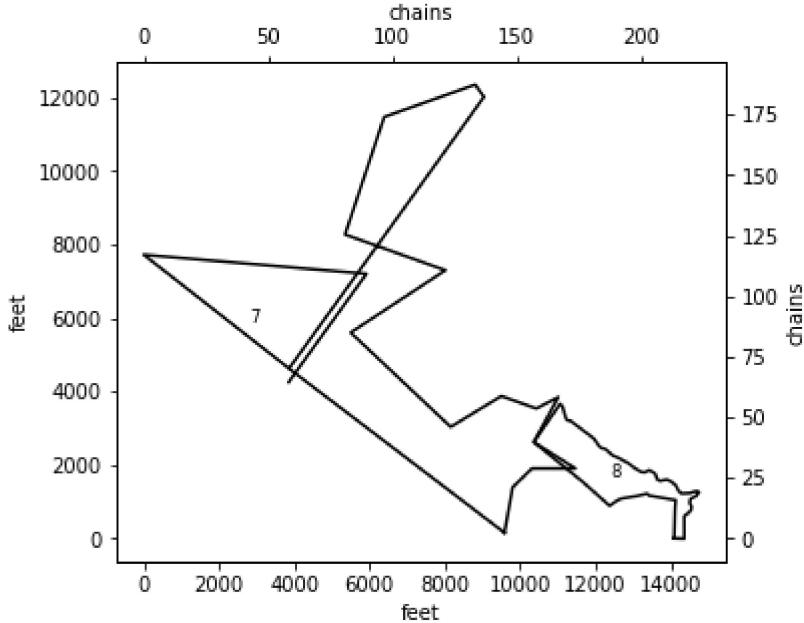
"ALL THAT CERTAIN TRACT OR PARCEL OF LAND situate, lying and being in the Town of Shandaken, in the County of Ulster and State of New York and is a part of Lot Number 8 in division 2 Great Lot 7 Hardenburgh Patent and is bounded as follows, viz: BEGINNING at a heap of stones near a beech tree against the southeast side of the Withenburgh Mountain in the Division line between Divisions two and three and a corner of lots number 8 and 9 and runs then""



```
In [19]: # The jigsaw report quotes the descriptions of where parcels I and VII meet,  
# and the descriptions are basically identical.  
# Parcels I and VIII also line up, with somewhat less certainty, since Parcel I  
# describes multiple corners as "a heap of stones on a ledge of rocks".  
# In this case parcel #12 looks like the right corner in Parcel I.
```

```
parcel.Jigsaw([parcel1, parcel7, parcel8],  
    names = ["p1", "p7", "p8"],  
    labels = ["", "7", "8"],  
    conditions = ["p1's Withenceg is p7's Wittenburgh",  
                  "p1's 12 is p8's ledge"])).Report()
```

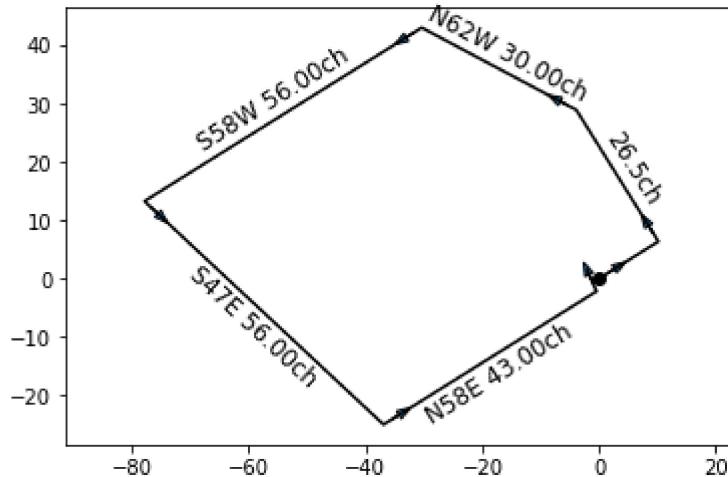
p1's Withenceg is p7's Wittenburgh
 "a heap of stones against the southeast side of the Withenceg Mountain, a corner of Lots 8 and 9 in Division 2 and 3,"
 "ALL THAT CERTAIN TRACT OR PARCEL OF LAND situate, lying and being in the Town of Shandaken, in the County of Ulster and State of New York and is a part of Lot Number 8 in division 2 Great Lot 7 Hardenburgh Patent and is bounded as follows, viz: BEGINNING at a heap of stones near a beech tree against the southeast side of the Wittenburgh Mountain in the Division line between Divisions two and three and a corner of lots number 8 and 9 and runs then"
 p1's 12 is p8's ledge
 "a heap of stones on a ledge of rocks"
 "a point marked by stone set on end in a pile of stones on a rock ledge""



```
In [20]: # Now we go on to parcel II, whose description is complete
desc2 = parcel.split_deed(ShultisA, "PARCEL I", "PARCEL III")
parcel2 = parcel.Parcel(desc2)
parcel2.Test()
```

```
Out[20]: '[0]: ALL THAT TRACT OF LAND in said Towns of Olive and Shandaken in said County of Ulster, adjoining the above Parcel I, and bounded and described as follows: - 7 BEGINNING at a heap of stones near a hemlock tree in the line of formerly John i 'Fnnist, Jr., now Garrison Davis, being the north corner, and runs from then along " the same | North | 58 degrees | East | 12 | chains | to a heap of stones on the line of said Davis by a small brook ' against the Blackberry Mountain; ',
[1]: then | North | 32 degrees | West | 26.50 | chains | to the division ii line of the Towns of Olive and Shandaken, a heap of stones on said line; ',
[2]: then | North | 62 degrees i | West | 30 | chains | to stones and a rock and a small hemlock tree on the North side of a ridge; and',
[3]: then through the hollow of the .west branch of the Withenceg Stream | South | 58 degrees | West | 56 Z | chains | to a heap of stones against the North side of the second ridge of mountain in a stony place; ',
[4]: then along the North side of said ridge, | South | 47 degrees | East | 56 | chains | to a heap of stones by a beech tree marked E. B. M. L. 1847;',
[5]: then | North | 58 degrees | East | 43 | chains | to a hemlock tree near a bridge across the north branch of said Withenceg Stream in the line of Garrison Davis af oresaid and',
[6]: then | North | 24 degrees | West | about 4 | chains | to the place of beginnin g.'
```

```
In [21]: parcel2.Report()
# The report shows that:
# The stated courses end close to the beginning, with an error of 2.5 chains.
# They enclose an area of 323 acres, more than the stated area of 300 acres.
```

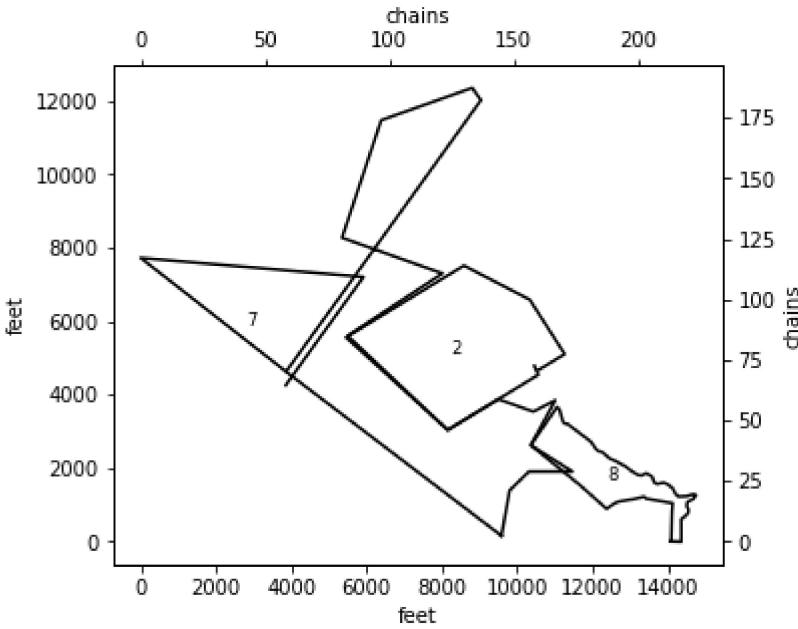


```
Out[21]: {'distances (x,y,diagonal)': [-2.05, 1.49, 2.535],
'areas (calc,stated,diff)': [323.058, 300.0, 23.058],
'warnings': ['', '', '']},
None,
[]]
```

```
In [22]: # Parcels I and II line up well at a marked beech tree.
```

```
parcel.Jigsaw([parcel1, parcel2, parcel7, parcel8],
    names = ["p1", "p2", "p7", "p8"],
    labels = ["", "2", "7", "8"],
    conditions = ["p1's beech is p2's beech",
                  "p1's Withenceg is p7's Wittenburgh",
                  "p1's 12 is p8's ledge"]).Report()
```

p1's beech is p2's beech
 "stones, being a beech tree marked E.B. 1847 M.L. about 10 links from a ledge of rock
 s on the. south side of the mountain"
 "a heap of stones by a beech tree marked E. B. M. L. 1847"
 p1's Withenceg is p7's Wittenburgh
 "a heap of stones against the southeast side of the Withenceg Mountain, a corner of Lo
 ts 8 and 9 in Division 2 and 3,"
 "ALL THAT CERTAIN TRACT OR PARCEL OF LAND situate, lying and being in the Town of Sha
 ndaken, in the County of Ulster and State of New York and is a part of Lot Number 8 i
 n division 2 Great Lot 7 Harden= burgh Patent and is bounded as follows, viz: BEGINNI
 NG at a heap of stones near a beech tree against the southeast side of the Wittenburgh
 Mountain in the Division line between Divisions two and three and a corner of lots nu
 mber 8 and 9 and runs then"
 p1's 12 is p8's ledge
 "a heap of stones on a ledge of rocks"
 "a point marked by stone set on end in a pile of stones on a rock ledge""



```
In [23]: # On to Parcel III, with a very short description.
desc3 = parcel.split_deed(ShultisA, "PARCEL III", "PARCEL IV")
parcel3 = parcel.Parcel(desc3)
parcel3.Test()

Out[23]: ['[0]: ALL THAT TRACT OF LAND in the Town of Olive in said County of Ulster, nt adjoi
ning the above Parcel I and II and bounded and described as follows: Davis, and runs
from then | South | 62 degrees | West | 10 | chains | to stones;',
 '[1]: then | North | 70 degrees | West | 15 | chains | to a . heap of stones;',
 '[2]: then | North | 62 degrees | East | about 18 | chains | to the hemlock tree at
the end of the bridge “ across the Withenceg Stream; and',
 '[3]: | | | | | then down the same as it winds and turns to the place of']

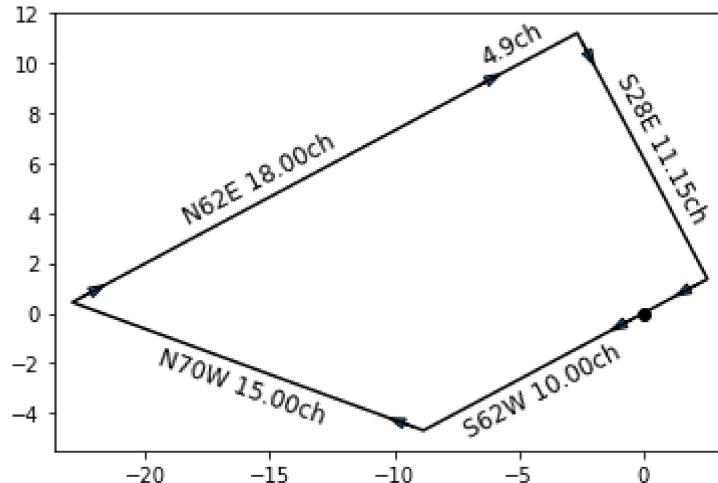
In [24]: # The test shows that some courses are not described fully.
# The end of the boundary is described as winds and turns of a creek.
# Since there is a stated area, we can infer three Lengths.
# So the inputs here assume turns by angles of 0, 90, 90, and 0 degrees,
# which is one reasonable possibility among many.

normalizations = [[["then down the same"],
                   ["then N 62 degrees E unknown1 chains, " +
                    "then S 28 degrees E unknown2 chains, " +
                    "then S 62 degrees W unknown3 chains"]]

parcel3 = parcel.Parcel(desc3,
                        normalizations = normalizations,
                        targetarea = "stated")
parcel3.Test()

Out[24]: ['[0]: ALL THAT TRACT OF LAND in the Town of Olive in said County of Ulster, nt adjoi
ning the above Parcel I and II and bounded and described as follows: Davis, and runs
from then | South | 62 degrees | West | 10 | chains | to stones;',
 '[1]: then | North | 70 degrees | West | 15 | chains | to a . heap of stones;',
 '[2]: then | North | 62 degrees | East | about 18 | chains | to the hemlock tree at
the end of the bridge “ across the Withenceg Stream; and',
 '[3]: then | north | 62 degrees | east | unknown1 | chains, | ',
 '[4]: then | south | 28 degrees | east | unknown2 | chains, | ',
 '[5]: then | south | 62 degrees | west | unknown3 | chains | as it winds and turns t
o the place of']
```

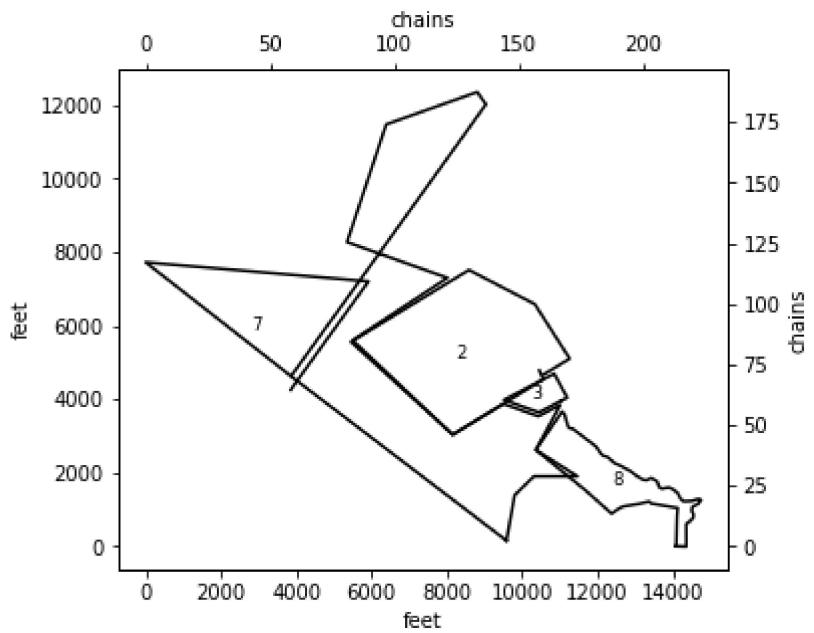
```
In [25]: parcel3.Report()
# Now we have lengths which match the constraints.
```



```
Out[25]: [{'distances (x,y,diagonal)': [-0.0, 0.0, 0.0],
  'areas (calc,stated,diff)': [19.995, 20.0, -0.005],
  'warnings': ['', '', ''}],
None,
["inferring 'unknown1' to '4.956'",
 "inferring 'unknown2' to '11.147'",
 "inferring 'unknown3' to '2.919']]
```

```
In [26]: # Parcels 2 and 3 line up well at a bridge.
parcel.Jigsaw([parcel1, parcel2, parcel3, parcel7, parcel8],
    names = ["p1", "p2", "p3", "p7", "p8"],
    labels = ["", "2", " 3", "7", "8"],
    conditions = ["p1's beech is p2's beech",
                  "p2's bridge is p3's bridge",
                  "p1's Withenceg is p7's Wittenburgh",
                  "p1's 12 is p8's ledge"]).Report()
```

p1's beech is p2's beech
 "stones, being a beech tree marked E.B. 1847 M.L. about 10 links from a ledge of rock
 s on the. south side of the mountain"
 "a heap of stones by a beech tree marked E. B. M. L. 1847"
 p2's bridge is p3's bridge
 "a hemlock tree near a bridge across the north branch of said Withencegh Stream in th
 e line of Garrison Davis aforesaid"
 "the hemlock tree at the end of the bridge " across the Withenceg Stream,""
 p1's Withenceg is p7's Wittenburgh
 "a heap of stones against the southeast side of the Withenceg Mountain, a corner of Lo
 ts 8 and 9 in Division 2 and 3,"
 "ALL THAT CERTAIN TRACT OR PARCEL OF LAND situate, lying and being in the Town of Sha
 ndaken, in the County of Ulster and State of New York and is a part of Lot Number 8 i
 n division 2 Great Lot 7 Harden= burgh Patent and is bounded as follows, viz: BEGINNI
 NG at a heap of stones near a beech tree against the southeast side of the Wittenburgh
 Mountain in the Division line between Divisions two and three and a corner of lots nu
 mber 8 and 9 and runs then"
 p1's 12 is p8's ledge
 "a heap of stones on a ledge of rocks"
 "a point marked by stone set on end in a pile of stones on a rock ledge""



In []: