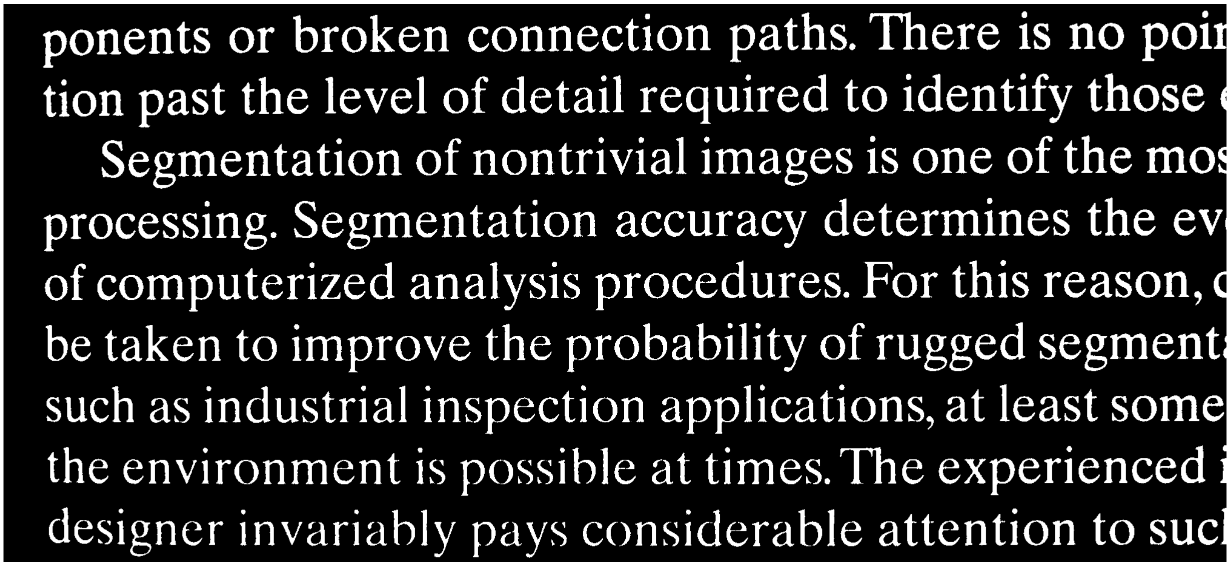
Task 5: Morphological Operations

Given the following image, identify 'O' in the image using morphological operations.



ponents or broken connection paths. There is no poi
tion past the level of detail required to identify those
Segmentation of nontrivial images is one of the mos
processing. Segmentation accuracy determines the ev
of computerized analysis procedures. For this reason,
be taken to improve the probability of rugged segment
such as industrial inspection applications, at least some
the environment is possible at times. The experienced
designer invariably pays considerable attention to suc

In [326]:

```
import cv2
import numpy as np
import matplotlib.pyplot as plt
import urllib

%matplotlib inline

# Read image from URL
req = urllib.request.urlopen('https://raw.githubusercontent.com/omzlette/FRA321_E
arr = np.asarray(bytearray(req.read()), dtype=np.uint8)
oriimg = cv2.imdecode(arr, cv2.IMREAD_GRAYSCALE)
outimg = oriimg.copy()
```

In [327]:

```
def imreconstruct(mask, marker, ksize:tuple):
    se = cv2.getStructuringElement(cv2.MORPH_RECT, ksize)
    recon = marker
    reconold = np.zeros(recon.shape, dtype=np.uint8)
    while np.sum(np.sum(recon - reconold)) != 0:
        reconold = recon
        recon = cv2.dilate(recon, se)
        recon = cv2.bitwise_and(recon, mask)
    return recon
```

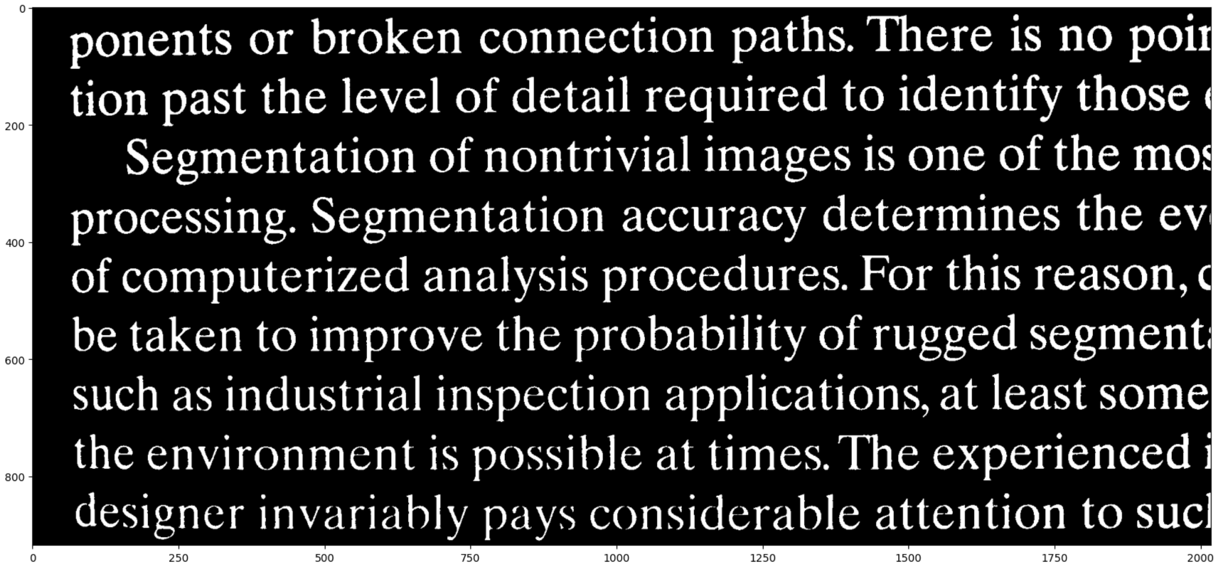
Remove as much characters as possible

In [328]:

```
se = cv2.getStructuringElement(cv2.MORPH_RECT, (2, 40))
longchara = cv2.erode(oriimg, se)

get2lines = imreconstruct(oriimg, longchara, (3, 3))

fig, axes = plt.subplots(2, 1, figsize=(30, 20))
axes[0].imshow(oriimg, cmap='gray')
axes[1].imshow(get2lines, cmap='gray')
```

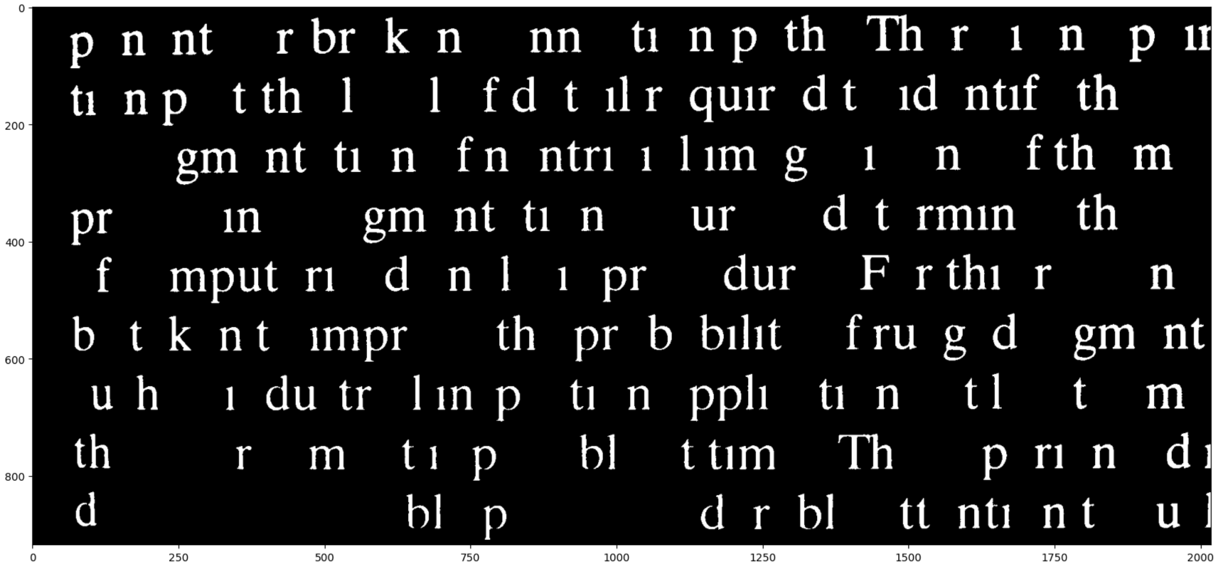
Out[328]:

```
<matplotlib.image.AxesImage at 0x14c071c1df0>
```



ponents or broken connection paths. There is no poir
tion past the level of detail required to identify those (
Segmentation of nontrivial images is one of the mos
processing. Segmentation accuracy determines the ev
of computerized analysis procedures. For this reason, c
be taken to improve the probability of rugged segment
such as industrial inspection applications, at least some
the environment is possible at times. The experienced i
designer invariably pays considerable attention to sucl

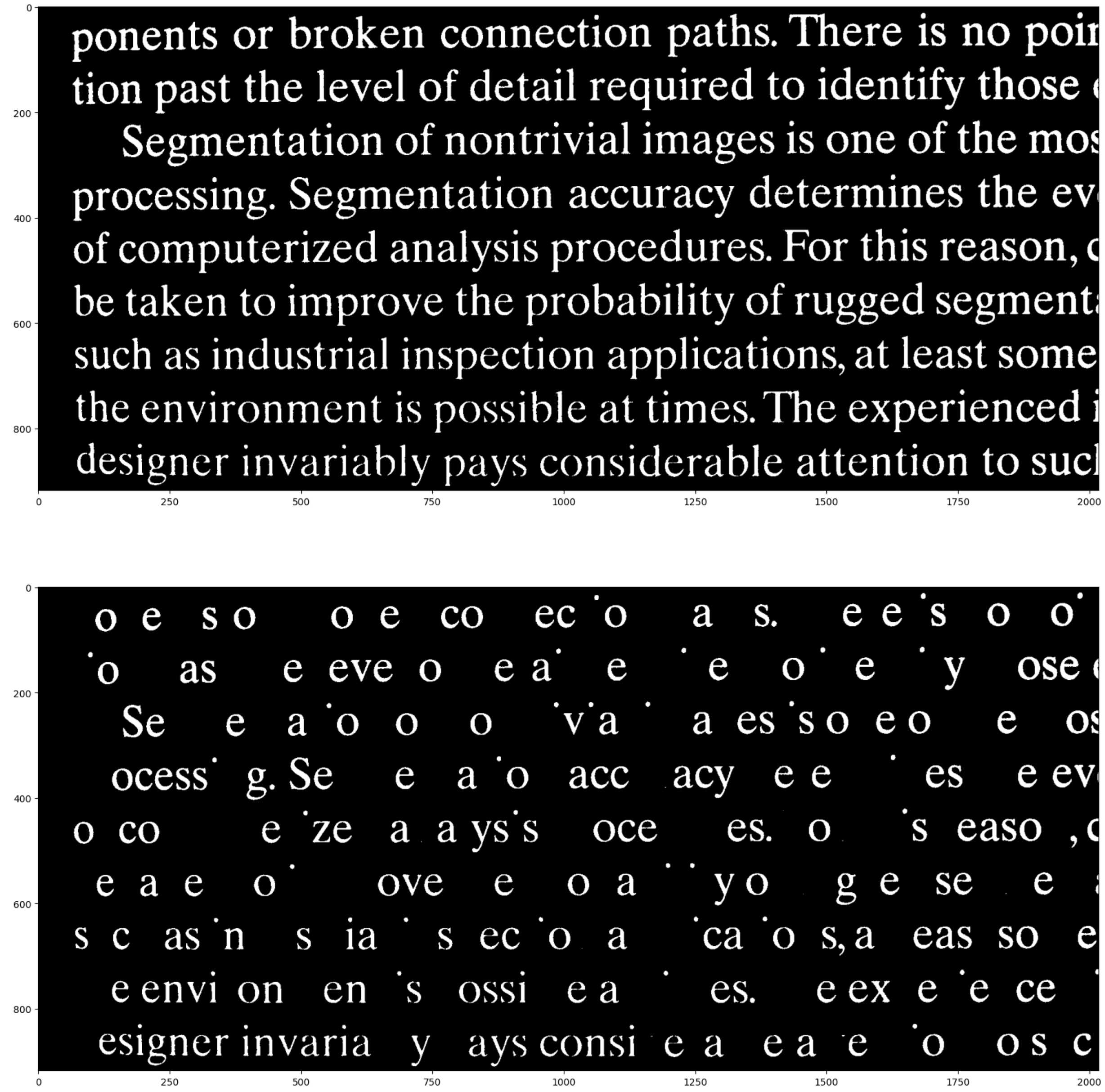
0
200
400
600
800
0
250
500
750
1000
1250
1500
1750
2000



p n nt r br k n nn tı n p th Th r ı n p ır
tı n p t th l l f d t ıl r quır d t ıd ntıf th
gm nt tı n f n ntrı ı l ım g ı n f th m
pr ın gm nt tı n ur d t rmın th
f mput rı d n l ı pr dur F r thı r n
b t k n t ımpr th pr b bılıt f ru g d gm nt
u h ı du tr l ın p tı n pplı tı n t l t m
th r m t ı p bl t tım Th p rı n d ı
d bl p d r bl tt ntı n t u l
0
200
400
600
800
0
250
500
750
1000
1250
1500
1750
2000

In [329]:
```
rm2lines = cv2.bitwise_not(get2lines)
rm2lines = cv2.bitwise_and(oriimg, rm2lines)

fig, axes = plt.subplots(2, 1, figsize=(30, 20))
axes[0].imshow(oriimg, cmap='gray')
axes[1].imshow(rm2lines, cmap='gray')
```

Out[329]:
```
<matplotlib.image.AxesImage at 0x14bea57e790>
```



ponents or broken connection paths. There is no poin
tion past the level of detail required to identify those
Segmentation of nontrivial images is one of the mos
processing. Segmentation accuracy determines the ev
of computerized analysis procedures. For this reason, c
be taken to improve the probability of rugged segment
such as industrial inspection applications, at least some
the environment is possible at times. The experienced i
designer invariably pays considerable attention to such

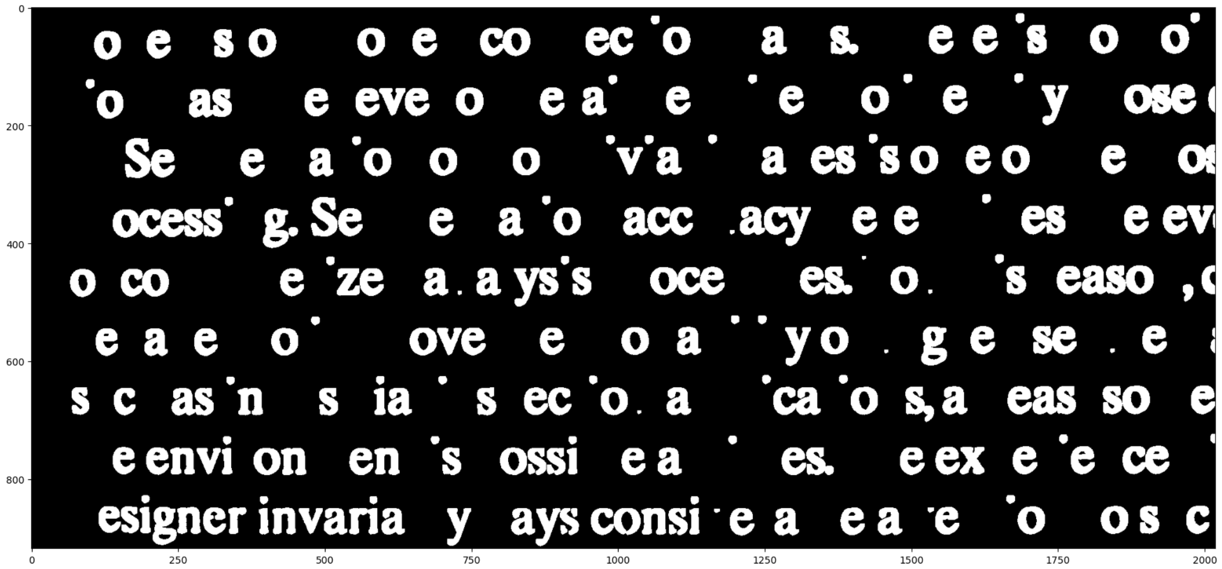
0
200
400
600
800
0
250
500
750
1000
1250
1500
1750
2000
o e s o o e co ec o a s. e e s o o
o as e eve o e a e e o e y ose
Se e a o o o v a a es s o e o e os
ocess g. Se e a o acc acy e e es e ev
o co e ze a a ys s oce es. o s easo , c
e a e o ove e o a y o g e se e
s c as n s ia s ec o a ca o s, a eas so e
e envi on en s ossi e a es. e ex e e ce
esigner invaria y ays consi e a e a e o o s c
0
200
400
600
800
0
250
500
750
1000
1250
1500
1750
2000

Dilate the image

Since some of the 'O's are disconnected, we need to dilate the image to connect them.

In [330]:
```
# openimg = cv2.morphologyEx(oriimg, cv2.MORPH_OPEN, cv2.getStructuringElement(cv
kernel = cv2.getStructuringElement(cv2.MORPH_ELLIPSE, (4, 4))
dilimg = cv2.dilate(rm2lines, kernel, iterations=2)

fig, axes = plt.subplots(1, 1, figsize=(30, 10))
axes.imshow(dilimg, cmap='gray')
# axes[1].imshow(img, cmap='gray')
```

Out[330]:
```
<matplotlib.image.AxesImage at 0x14c5732f760>
```



Fill in the holes

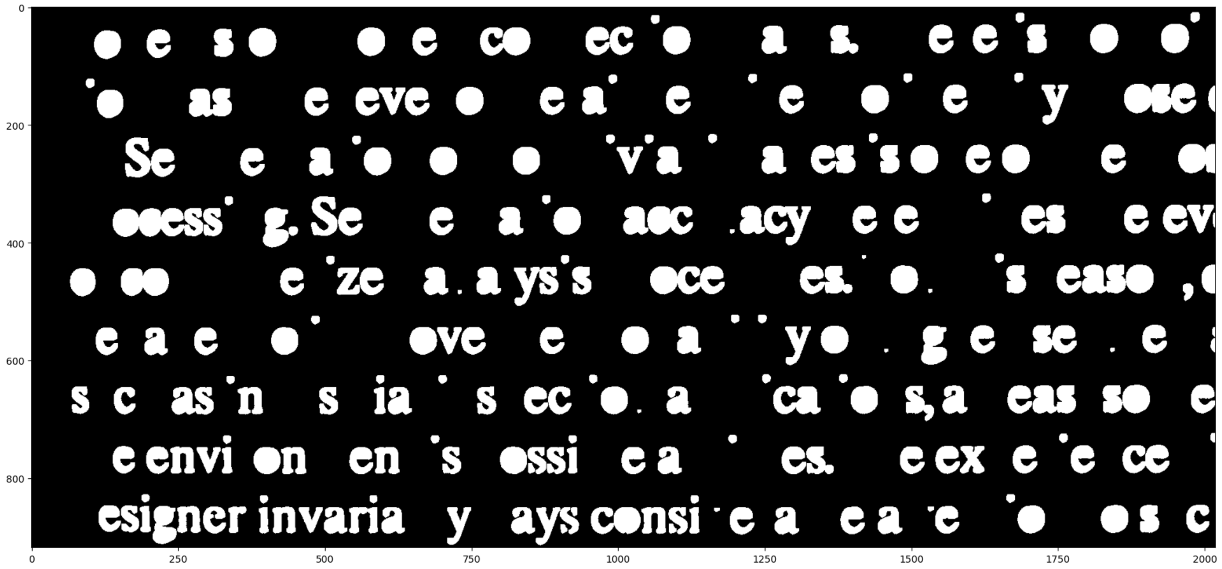
Then, we fill in the holes to make the 'O's solid.

In [331]:

```
_, dilimg_th = cv2.threshold(dilimg, 220, 255, cv2.THRESH_BINARY_INV)
filldilimg = dilimg_th.copy()

mask = np.zeros((filldilimg.shape[0]+2, filldilimg.shape[1]+2), dtype=np.uint8)
cv2.floodFill(filldilimg, mask, (0,0), 0)

invdil = cv2.bitwise_not(filldilimg)

out = cv2.bitwise_and(dilimg_th, invdil)
fillo = cv2.bitwise_not(out)

plt.figure(figsize=(30, 10))
plt.imshow(fillo, cmap='gray')
```

Out[331]:

```
<matplotlib.image.AxesImage at 0x14c07219f40>
```



Erode the image

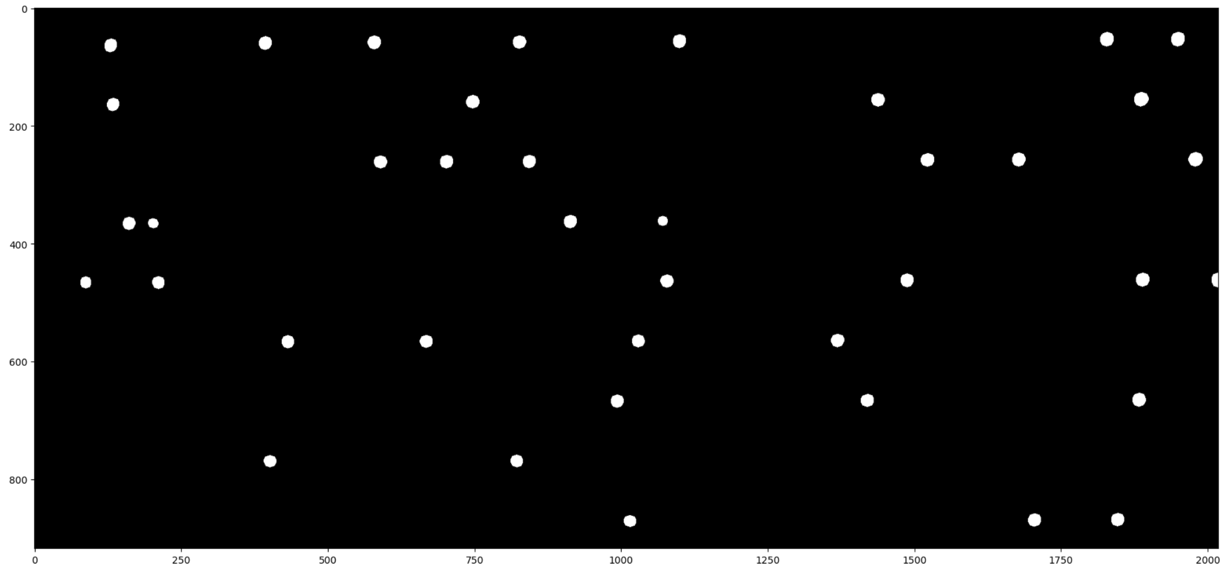
After that, we erode the image and use image opening to remove anything that is not 'O'.

In [332]:

```
se = cv2.getStructuringElement(cv2.MORPH_ELLIPSE, (9, 9))
outimg = cv2.erode(fillo, se, iterations=3)

# REMOVE NOISE
kernelSize = 9

opIterations = 2

maxKernel = cv2.getStructuringElement(cv2.MORPH_ELLIPSE, (kernelSize, kernelSize
openingImg = cv2.morphologyEx(outimg, cv2.MORPH_OPEN, maxKernel, iterations=opIte

plt.figure(figsize=(30, 10))
plt.imshow(openingImg, cmap='gray')
```

Out[332]:

```
<matplotlib.image.AxesImage at 0x14bfc1b68e0>
```



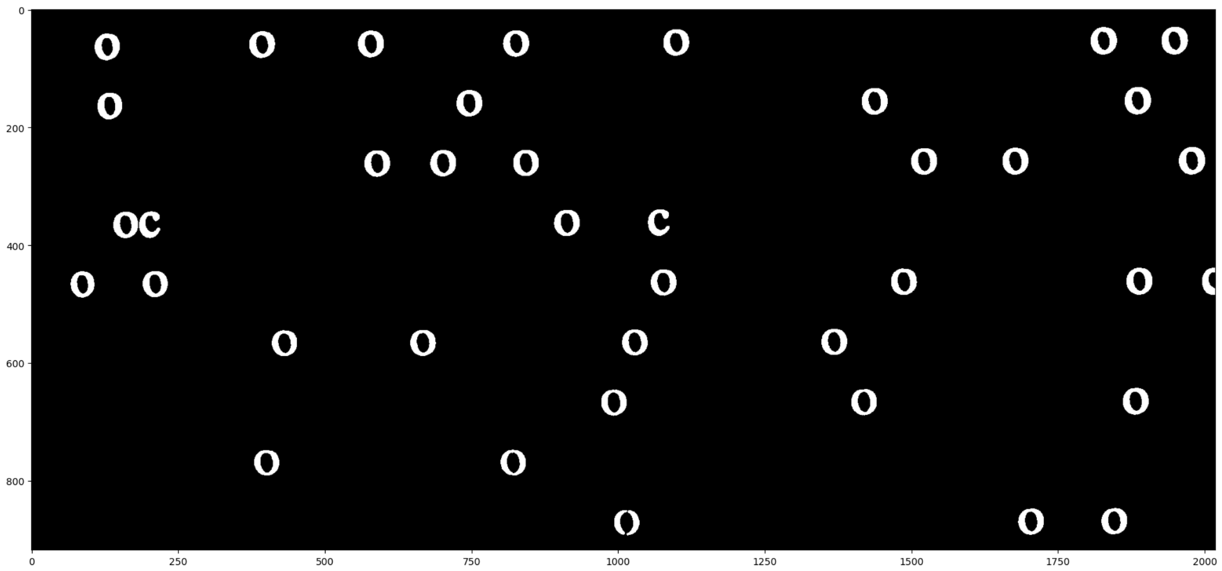
Reconstruct the image and we will get:

In [333]:

```
img4recon = cv2.dilate(rm2lines, kernel, iterations=1)

getleft = imreconstruct(img4recon, openingImg, (3, 3))

plt.figure(figsize=(30, 10))
plt.imshow(getleft, cmap='gray')
```

Out[333]:

```
<matplotlib.image.AxesImage at 0x14bfc21b040>
```



Remove remaining characters

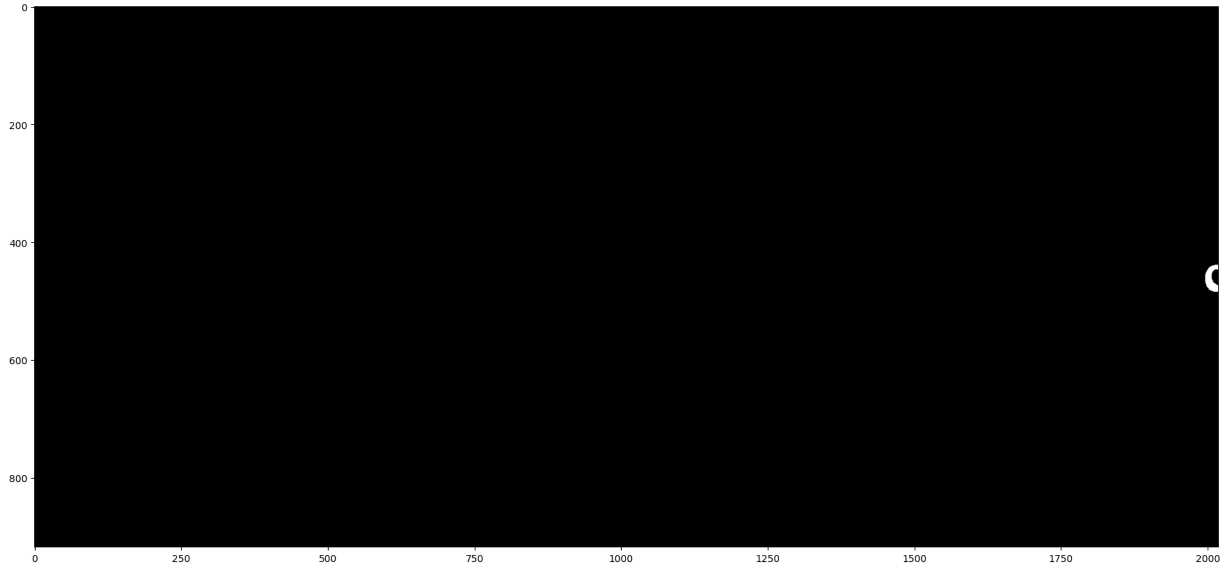
Since there are still some characters left, we need to remove them.

In [334]:

```
kernelLast = cv2.getStructuringElement(cv2.MORPH_RECT, (25, 6))
rmborder = cv2.erode(getleft, kernelLast, iterations=1)

rmborder = imreconstruct(getleft, rmborder, (3, 3))

plt.figure(figsize=(30, 10))
plt.imshow(rmborder, cmap='gray')
```

Out[334]:

```
<matplotlib.image.AxesImage at 0x14bfc284d60>
```

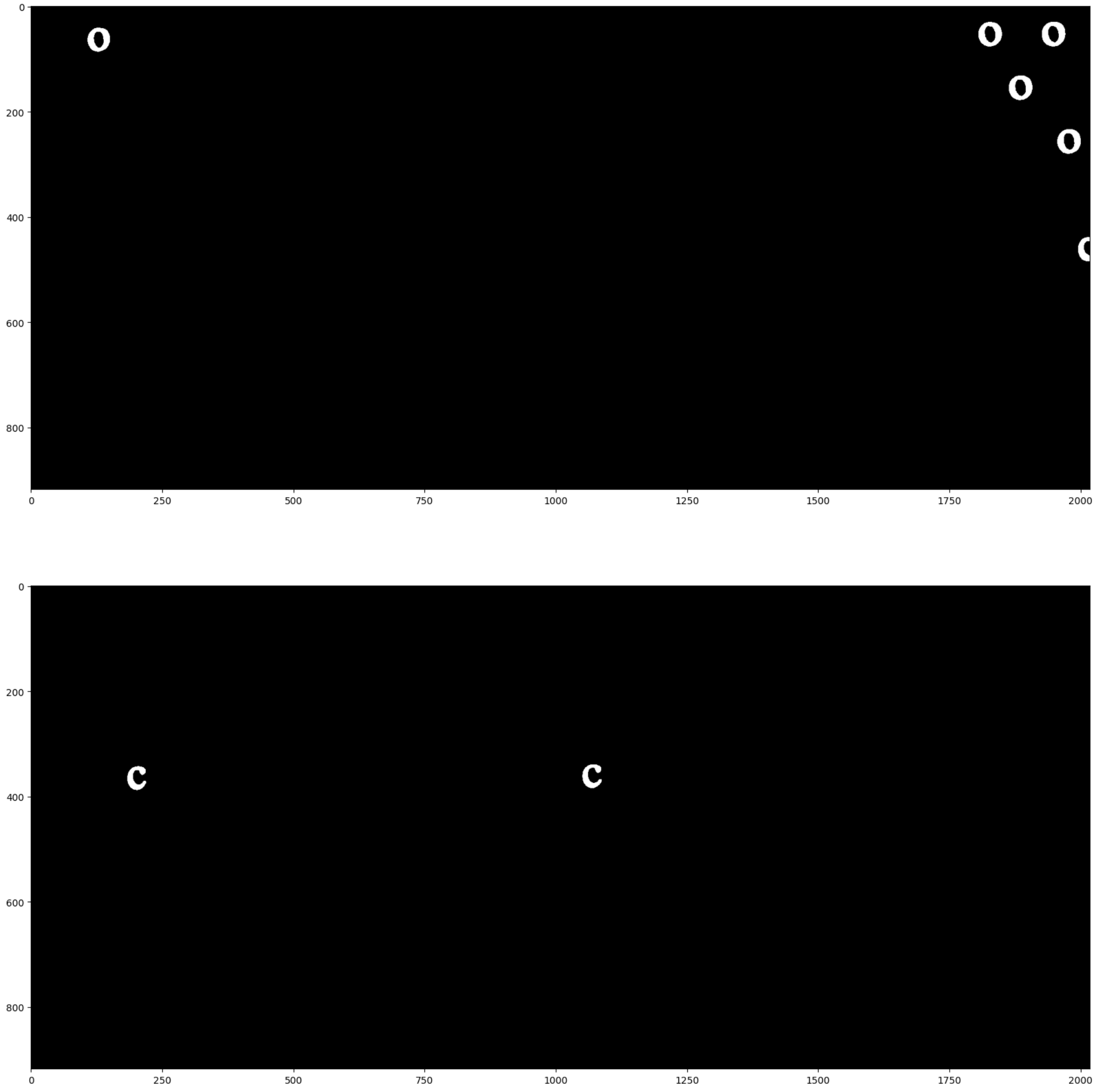


In [335]:

```
# kernelO4 = cv2.getStructuringElement(cv2.MORPH_RECT, (25, 8))
kernelER = cv2.getStructuringElement(cv2.MORPH_RECT, (9, 4))
er = cv2.erode(getleft, kernelER, iterations=2)
er = imreconstruct(getleft, er, (2, 2))
er = cv2.erode(er, kernel, iterations=2)
er = imreconstruct(getleft, er, (3, 3))

O4fig, axes = plt.subplots(2, 1, figsize=(30, 20))
axes[0].imshow(er, cmap='gray')

kernelC = cv2.getStructuringElement(cv2.MORPH_RECT, (9, 4))
getC = cv2.erode(getleft, kernelC, iterations=2)
getC = imreconstruct(getleft, getC, (3, 3))

getC = cv2.bitwise_xor(getC, er)

axes[1].imshow(getC, cmap='gray')
```

Out[335]:

```
<matplotlib.image.AxesImage at 0x14bfc2d9ac0>
```

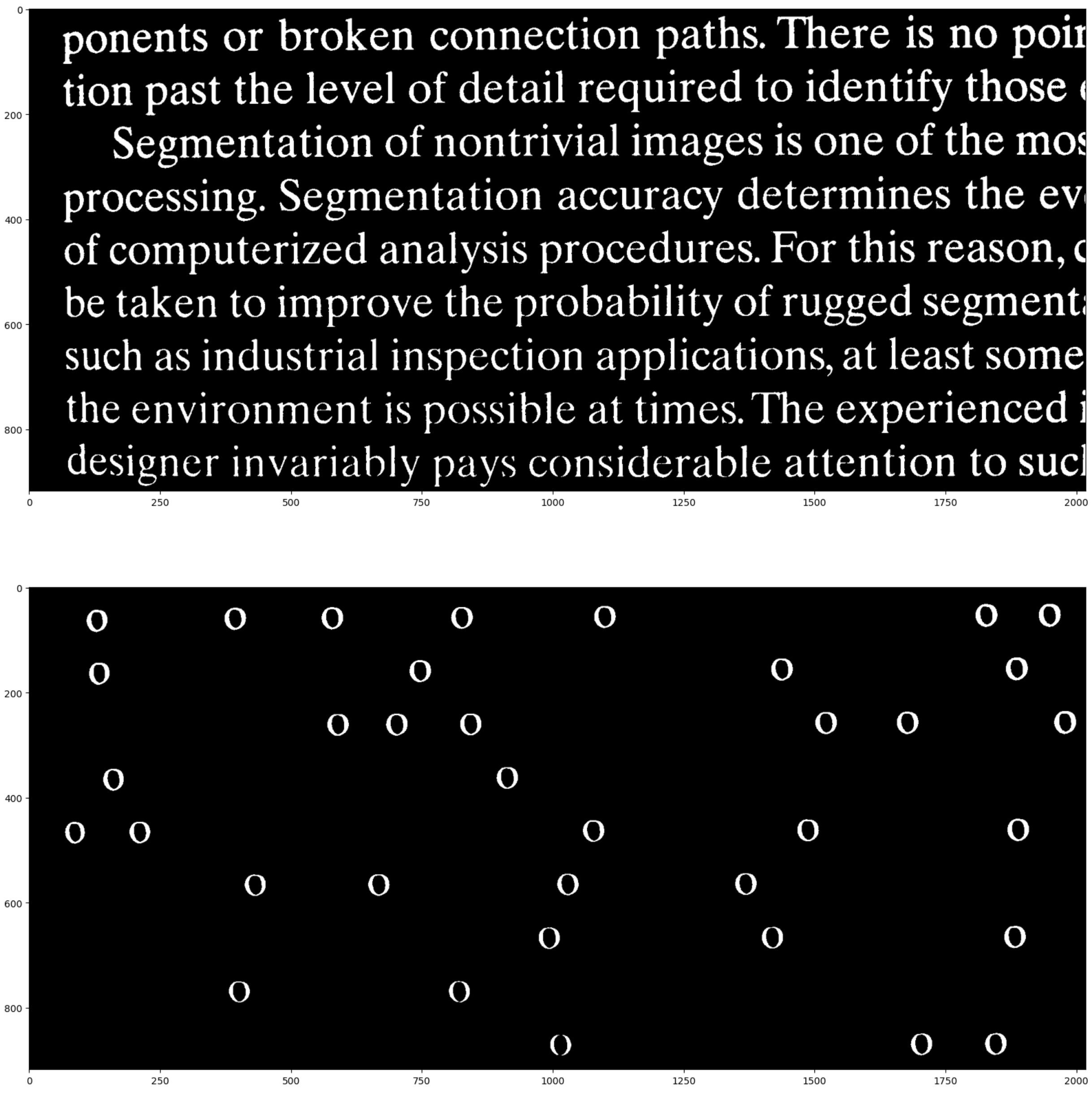


Result

Compare the result with the original image, we can see that the 'O's are identified correctly.

```
In [336]: resimg = cv2.bitwise_xor(getleft, getC)
          resimg = cv2.bitwise_xor(resimg, rmborder)
          resimg = cv2.erode(resimg, kernel, iterations=1)

          resfig, axes = plt.subplots(2, 1, figsize=(30, 20))
          axes[0].imshow(oriimg, cmap='gray')
          axes[1].imshow(resimg, cmap='gray')
```

```
Out[336]: <matplotlib.image.AxesImage at 0x14c028c6d30>
```



ponents or broken connection paths. There is no poir
tion past the level of detail required to identify those
Segmentation of nontrivial images is one of the mos
processing. Segmentation accuracy determines the ev
of computerized analysis procedures. For this reason, c
be taken to improve the probability of rugged segment
such as industrial inspection applications, at least some
the environment is possible at times. The experienced i
designer invariably pays considerable attention to sucl