Moth Breeding and Photography

Publication/Creation

1887-1891

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W.F. Kirby Brit. Mus. Nat H f.1

Common Silkworm (Bombyx Mori) – degenerated much by regeneration of them how soon.

Sphingidae
Acherontia Atropos, Chaerocampa Elpenor } larva is dimorphous – not the perfect insect

Noctua Acronycta Psi, Noctua c-nigrum } larva vary considerably – not perf. ins

Araschnia Levana (Weismann)

A.G. Butler

Orgyia antiqua. by [illegible] dead of the aborted wings of the female & the white spot in the forewings of the male

It would be an excellent moth to buy – is abundant, feeds on anything & the sexes are distinguishable in the larvae (color of dorsal tufts) so male & female can be kept separate.

In first generation if the females only are reared they will attract crowds of males from the neighbourhood & from these healthy partners can be selected

Swainson

Suggests the Bombacidae.

Kruegys, Lepidopteris Guide.

Mr. Frederic Merrifield's "*Report of Progress in Pedigree Moth-breeding, with observations on incidental points*," *and the discussion by* Mr. Francis Galton, F.R.S., Prof. Meldola, F.R.E., *and* Mr. E. B. Poulton, M.A.

[Reprinted, with some alterations and additions, from the Proceedings of the Entomological Society of London, 1887.]

Mr. Frederic Merrifield read a "Report of Progress in Pedigree Moth-breeding, with observations on incidental points." He also exhibited a large number of specimens of *Selenia illunaria*, showing the results of the experiments he had been making, and some from larvæ which had been beaten from forest trees. He said that, having obtained plenty of living specimens of *S. illunaria* in the spring, his experiments with that species were more advanced than with *S. illustraria*. From eggs of *illunaria* laid by moths taken in the spring he had reared a second generation fed on fastened birch trees, the moths emerging in July. From these he had made a selection of long-winged (A), medium-winged (M), and short-winged (Z) pairs, and from each of these pairs he had batches of pupæ numbering from 60 to 100, now hybernating. Besides the insects thus reared under natural conditions, he had reared some which were kept during all their stages in an artificial temperature averaging a little under 80° Fahr. In this way he had obtained four successive generations, and from the last of them, being the fifth generation of the year, counting a generation as beginning with the egg (the moths caught in the spring reckoning as belonging to the first), he had three selected broods, comprising between 200 and 300 larvæ, now feeding, some few being nearly full-fed. The forced second generation was distinctly larger than the same generation showed, and each successive forced generation showed a measurable increase in size over its predecessor. From the forced second generation he had selected A, M, and Z pairs, from each of which he had reared a number of moths, but the A's and Z's in this third generation failed to produce fertile eggs, though several pairs of each were tried. The M's produced abundantly, and from one of these M pairs he bred 61 moths, from which he had again selected A's, M's, and Z's, which laid fertile eggs, and from these pairs he had the three broods of larvæ above referred to as now feeding, some of which he exhibited. He refrained at present from any inferences as to the cause of the sterility of the third generation of forced moths in the A and Z lines, but thought it would be prudent in these experiments to include some selections from points in the scale of size considerably short of the extremes. All the successive generations were of the summer type (*fabricia*). In all the female was, on the average, sensibly larger than the male, but in the natural spring emergence the reverse was the case. *S. illunaria* was the only English double-brooded Geometer, except perhaps *T. lariciaria*, which had one of its emergences in a winter month, and he threw out the suggestion whether the relatively smaller size of the female in the first emergence might be a step towards or a remnant of apterousness, usual in the female of our winter moths. It would be interesting to breed and compare *T. lariciaria*. He could not undertake any other species than *illunaria* and *illustraria*, and circumstances might interfere even with them; and as the experiments with them must continue for many generations in order to reach the results wanted for Mr. Galton's purposes, and required uninterrupted watchfulness, it was essential, to prevent an accidental failure, that there should be a second line of experiments conducted independently. Both species were very easy to rear, and offered much scope for experiment in various directions; he would gladly supply eggs in the spring for the purpose. Mr. Merrifield further said he should be glad to be afforded the opportunity of seeing and, if judged expedient, breeding from unusual varieties or types of either species, or examples from Ireland, Wales, Northern regions such as Scotland and Scandinavia, where both species appear to be single-brooded, or from Central or Southern Europe. *S. lunaria* would be an interesting subject; and he should like to know whether in the resting position it approximated to *illunaria*, which folds its wings closely together like a butterfly, or to *illustraria*, which holds them at an angle of 50° or 60°. He exhibited two diagrams, one showing the measurements of the successive broods, and the other the duration of the larval and other stages in each; also a number of specimens of each brood of *illunaria*, and several of *illustraria*.

Mr. Francis Galton alluded to the close attention Mr. Merrifield had given to the subject, and complimented him on the neatness, ingenuity, and skill with which he had conducted his experiments, which he considered were of a very high order. He hoped that other members of the Society would assist Mr. Merrifield by making similar experiments. Mr. Galton said his own part of the work had not yet commenced, but he hoped to begin it next March. He made some observations on acquired faculties, and on the possibility of mutilations being inherited. He believed that mutilations in the legs of larvæ affected the legs of the moth.

Prof. Meldola expressed his admiration of the manner in which Mr. Merrifield had conducted these experiments, and hoped that they would be successfully continued. He suggested that the opportunity afforded by such wholesale experiments should be utilized for the purpose of getting accurate measurements of the relative variability of certain selected characters in the moth, in addition to the size, which character only was required for Mr. Galton's purpose. Thus, by carefully measuring the length of the antennæ, the distance between certain definite markings on the wings, &c., in all the individuals of several distinct broods, data would be obtained for expressing numerically the relative amount of variability of the parts stated in terms of the mean or average measurement. Observations of this kind had been conducted on birds by Mr. Allen in North America, and had served to show the extreme relative variability of all the parts. Accurate measurements of this variability were much needed for large numbers of individuals belonging to widely different species in as many diverse groups of the Animal Kingdom as possible. By this means naturalists would in the future be better able to realise the degree of plasticity of different organisms. Such information, which might well be supplied by entomologists for insects, would be of great value as a contribution to the theory of Natural and Sexual Selection.

Mr. Poulton said he was much interested in the results of Mr. Merrifield's experiments. He was extremely astonished to learn that an insect parasite and a perfect although much dwarfed image had been bred from a *Selenia* pupa. At the same time he remembered that Prof. Westwood had shown him a dipterous parasite which had escaped from a cocoon of *Trichiosoma lucorum*, and from which the hymenopterous insect had also emerged. Mr. Poulton thought that Mr. Merrifield's experiments offered a most favourable opportunity for practically testing whether acquired characters can or cannot be transmitted. It was well known that certain larval organs were the morphological equivalents of the corresponding pupal and imaginal structures. Thus Mr. Poulton had found that when the six ocelli of a lepidopterous larva had been destroyed, the compound eye was not developed in the pupa or in the image. If any one of the larval thoracic legs were cut off, the corresponding leg would almost certainly be absent in the two later stages. Among all previously recorded cases there had been no instance in which the effects of mutilation had been proved to be transmissible to offspring. Prof. Weismann, of Freiburg, had lately given many reasons for believing that the transmission of acquired characters (such as mutilations) cannot take place. But, as Mr. Francis Galton had said, in all such previous cases the injury had been inflicted comparatively late in life (as, in Mammalia, never before the close of intrauterine development), and in order to finally show that such effects are not transmitted they should be produced as early as possible in the life of the parent. Such facilities are offered by Lepidoptera, for their larvæ have been correctly described as "embryos leading an independent life," and the morphological interval which separates this stage from the two later stages is perfectly stupendous, completely dwarfing the differences between the latter into insignificance. Mr. Poulton therefore considered that if after the systematic mutilation of a large number of larvæ there was no trace of the effects in any individual of the next generation, the result must be taken as strongly confirmatory of Prof. Weismann's view.

Mr. Frederic Merrifield's "*Report of Progress in Pedigree Moth-breeding, with observations on incidental points,*" *and the discussion by* Mr. Francis Galton, F.R.S., Prof. Meldola, F.R.S., *and* Mr. E. B. Poulton, M.A.

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f.1

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Gold Medal Paris Electrical Exhibition 1881.

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101 & 102, St Martin's Lane,
London, July 3rd 1890.
W.C.

F. Galton Esqre
42 Rutland Gate.
S.W.

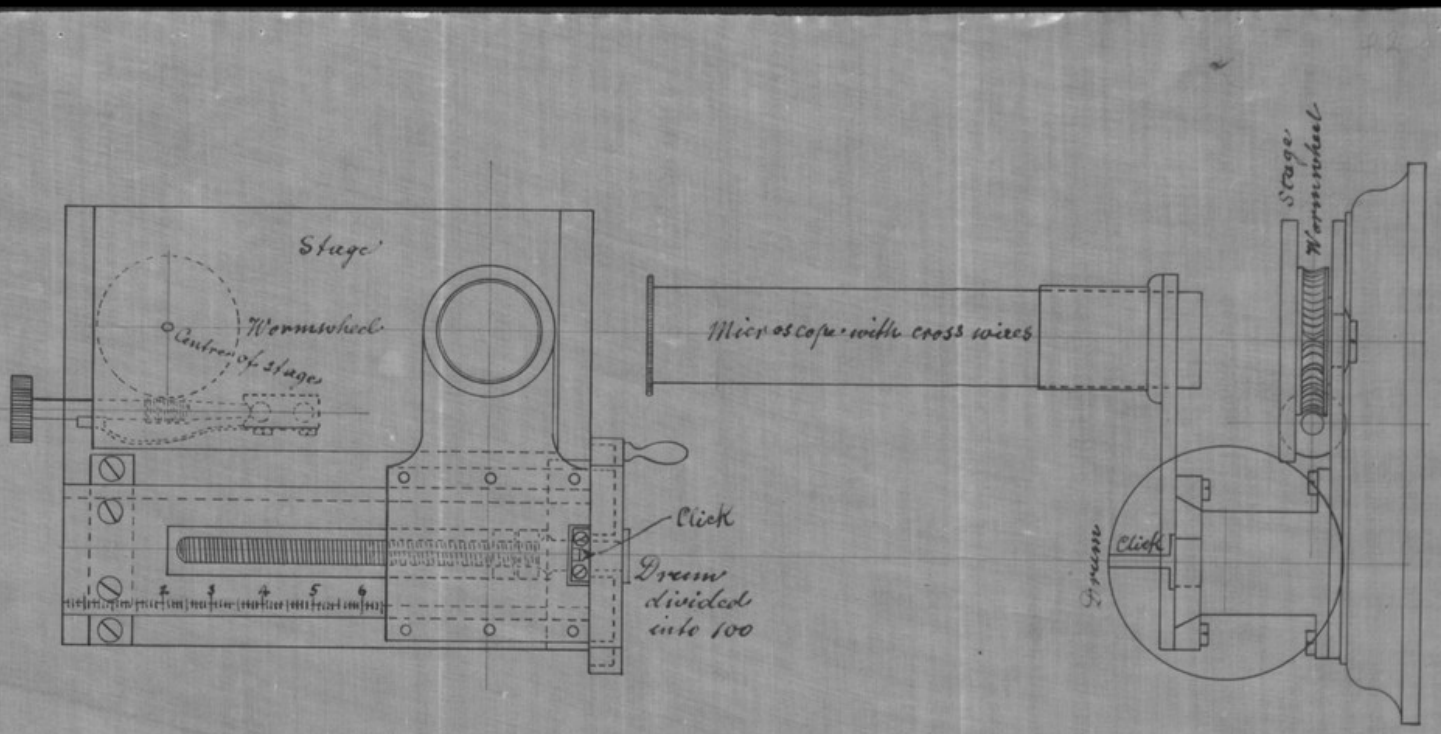
Sir,

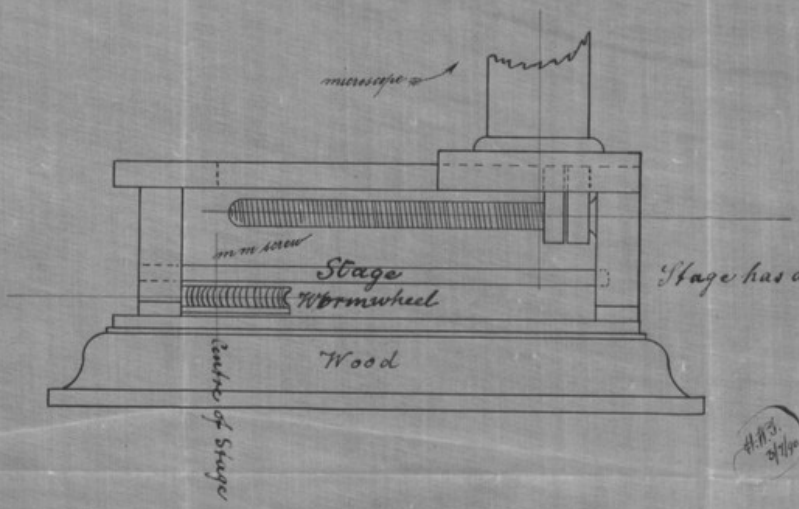
As promised we have pleasure in enclosing sketch of micrometer Microscope for your approval.

The price of the above Instrument would be £6. 6. 0. (Six Guineas.)

Awaiting your command which shall receive our best attention.

We are, Sir,
yours obediently,
For Elliott Brothers.
W. Kieser





Stage has a large sweep

H.H.S. 31/1/90

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f.1r

9 April 1887

My dear Mr

Saturday, if you find it suits you, will suit me very well to lunch about 1.30.

I am still exercised in my mind about measuring the mother while alive, which I think if any trouble is to do with fair accuracy. If no slow flow occurs I think they might be dropped between 2 pieces of thin glass tubes

and then measured by scale & magnifier

Yours very truly
F. Galton

There are two appliances
that can be got better in London
than here, & if you fall in the
way of them, I should be much
obliged if you would look at
them, & tell me how we must.
One is a very simple one - viz the
millimetre scale - the cheaper the
better, if accurate.

And then is much more-
-ing a balance delicate enough to
weigh minute differences. Not I
imagine will be an expensive affair.
But I think it can be quite
dispensed with so far as these
experiments are concerned, only
I should like them a little about
it, if you happen to know.

Some common Spunj (or perhaps
rather writing) paper taken a
week ago are still quite damp. I
have just given them all a little
food, & expect them to live much
longer yet. Those that have died
may have been old & how they
were caught.

All my apparatus so far,

RETURN TO
H. G. F[illegible]
[illegible]
Peconic, N. Y.

Moths (XI 11)

What little remains of the many papers I returned Mrs Merrifield table & hair on Jan 8/98

The negatives & [illegible] are in the cellar

42 Rutland Gate.
Francis Galton, Esq.,
London,
Eng.

11.

72v

36 : 88 :: 800 :

200
400
800

× 88/36 = 9

Westmoreland Lodge
Wimbledon Park
June 25

Dear Mr. Galton,

I am very glad you can come to lunch on Thursday - The new line is a decided help to us from your end of town - Trains leave Gloucester Road at 12. & 5 & 7/8 / 15 Wadhurst

here at 1.32 / 1.33.
Our Station is South-
fields (not Wimbledon
Park!) and it is
hardly more than
half a mile from this
house. If I do not
hear again, I will
expect you by the
earlier train and
will meet you so
that you may not

lose the way. Our
road is called Inner
Park Road, but the
best landmark to
enquire for is S. Paul's
Church, to which we
are almost next
door —

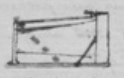
Sincerely yrs.
H. R. Pridham

f.1r Southover. Heene Wellring
1st August. 90

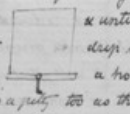
Dear Sir. I am sending proofs of the plates I have tried, but fear they are not accurate enough for measuring. My camera is not rigid & I ordered side struts on the day of my return to ensure keeping the front & back at right angles, but they were so long in coming that I began without them; & failed to get a correct outline. At last they came, but of too large a size, & as Mr Merrifield goes aboard on 11th shortly, I thought it best to cut one down & try that, & the other I used horizontally for to avoid risk of the thumb screws slipping & the screen & copying board getting out of parallel,

The last plates I have done show a great improvement in accuracy, developed last night some I sent Mr Merrifields July 31st There is so very little space to spare & my camera is so shaky that I almost despaired of getting it into fit condition to use successfully. But the addition of these screwed struts is a great improvement the front is still shaky but I have a small T square 2" which I might fix a thumb screw to press against the back (which when the 2nd strut is fixed will be quite rigid) & so press the front forward to a quite vertical position.

? cannot another diagonal be used.



The other. & I hope last defect appears in these 3 last prints & that is easily remedied. My metal dark slides have no catch to confine them when placed in position for exposing, but the focussing handle has hitherto answered as a support for slides placed vertically,



& until I developed these last plates I hadn't noticed that it allowed the slide to drop slightly lower, when the handle was turned a ¼ circle round, from a horizontal to vertical position I am sorry to have wasted these plates & it is a pity, too as they are otherwise fairly correct. Plate 8 is the only one taken since the adjustments were improved.

I think I must in future photograph only when the 4 divisions of 8 plates are arranged, & get everything ready in advance as far as possible, all the slips & numbers cut out etc. Then I could expose 8 plates in a day, under almost the same conditions, & we could be certain of no alteration in the adjustments by taking a vigorous work at it, & leaving all in position till it was done. on Mr Merrifields return.

Other sources of inaccuracy which are hardly avoidable under present conditions are slight undulations in the paper where the slips are pasted on the paper. they also are present in pressing the paper into the drawers.

The sheets are too wide to go in without cutting. on the pyramids

Those for even numbers (Plate 2. 4. etc) I cut off close to the black line & pin them into position with fine pins? possibly this might answer for the headings also, with pins cut down; even with very little paste there must be some unevenness with thin unmounted paper. If this answered 8 pins might be put

× at the distance of ½ inch from the marginal line of the left hand sheet

Stick the pens in the black lines at the 4 corner points. Preferably fine black pins — but

to fit, & permanently fixed in the drawers & only the headings changed for different plates, thus saving time, the draw backs being that there would be pinholes left visible when moths didn't fill all spaces.

But as they would print dark, I mean would be clear glass, they could be stopped out in the negatives, & it would on the whole save labour I think.

Perhaps another source of slight inaccuracy is that the image is seen through the thickness of the glass screen; when the lens is stopped down it is difficult to see the marginal lines of the lithographed form, as they are so very near the edge of the screen, & so much in the dark, I have to look at one side at a time, & may not always get my eye straight above the line. So anyhow I had better ask what amount of inaccuracy, if any, is permissible, so that I may know when to do a plate again.

Do you think I had better do this whole set of 8 again, when all adjustments are properly fitted, as the drawers are all arranged? & then cut out the ones which were somewhere the most nearly accurate, sum just those that have part of the negative cut off. I am sorry to waste plates, but I am reminded in these difficulties of what my painting master has sometimes said to me, "take a large piece of paper, you've got room to make mistakes."

A larger camera would reduce the difficulties in several ways & give a little "room to make mistakes", still I think it would be difficult to hire in Brighton, & it will perhaps cost less in time & money to risk wasting a few plates with mine. I have only used 3 orthochromatic plates as yet they certainly do give beautiful results & eikonogen suits them well. These blue prints are over & underprinted & you cannot judge from them they are the quickest & cheapest way of getting proofs — & require next to no washing — which is why I like them.

As to arrangement — Do you like the moths in vertical columns as Mr Merrifield started them & as they are in his store drawers?

Looking at your plans of the A M Z's it appears to me that yours succeed each other horizontally as words do.

Your way looks neat, & saves the 11th row sometimes, where the definition of the moths is worst. But it takes a whole row for "Females" instead of one compartment.

I have not discovered yet where "females continued" should go. It is suggestive of beginning a plate.

In the lithographed form, the vertical marginal lines are 7/8" over 12", but 6" is the very most I can include on the screen. but the printed heading only takes 5/8" above the numeral boundary lines which makes total length 1/8 short of 12". so that the exact outline for this in screen should be 5 1/2, which would be all the better for me.

The plates I understand are to be numbered continuously beginning from Spring 88, numbers to be printed over those that are printed on the A M Z slips. I see I have left out the family number in plate 8. (These #'s to be inserted)

If it should happen that this reaches you in time to answer these doubtful points before Mr Merrifield starts I should be glad to be able to report to him, but beyond getting all ready & cut out & perhaps rephotographing the present set I shall hardly do much more till he returns I should think.

Yours very truly

K. Marian Reynolds

Other plates to follow by book post


PLATE 47
SUMMER 1900
f.2r
I
II
III
1
2
3
4
5
6
7
8
9
10
11

The difference in the "from" between the points marked on the print is about as much as is marked at left end of this slip.

Tuesday.

Southover Worthing Aug 5. 90. I posted a letter to Rutland Gate by 4.30 post on Friday day 1st followed, at 6.30 p.m. by proofs of the plates which probably would not be delivered in London till next day. Mr. M. has just sent a list of the moths with complete particulars as to their labels etc. which will I hope, enable me to go on during his absence. I hope to go over on Thursday or Friday, to have probably a final inspection of them with him before he starts — so as to make as sure as possible about all particulars of arrangement.

In case from any cause my letter should have been delayed, it may be well to repeat here the questions I asked in it —. I am in hopes that the additional screwing arrangements which I am adding to my camera will greatly increase accuracy & that I may be able to keep the moths of succession drawers sufficiently in focus without making the least alteration in any part of the camera. Such a very slight movement alters the size, that it certainly would be best to keep the camera in position for as many sets of 8 plates as possible; still, in case I still get some variation in size, I should like to know if any easily detected variation is permissible, or should I repeat all that I find wrong in either direction (vertical or horizontal). The lines (vertical) on lithographed sheet are $\frac{3}{8}$ over 12"; but the printed heading only requires $\frac{5}{8}$" wh makes total length $\frac{1}{8}$" short of 12". can I consider this the boundary & mark 5 $\frac{5}{16}$" on the focussing screen, disregarding the highest line entirely: do these will probably be some variation in pasting the headings, vertical measurements will be less accurate, but I suppose they are of less importance also. The moths so far have been arranged succeeding each other in vertical columns, as in the store drawers, I gather from yr plan that they follow across horizontally, as words in a sentence. so that an empty row would be at base, wh would be better for lens, as definition is worst so very near edge of plate, but it takes a whole row for "Females" (heading) instead of one compartment. The plates I have done, previous to the additional arrangement of screws for focusing apparatus, are all more or less inaccurate. Shall I do the set again? & shall the moths succeed each other on column or across

K M Reynolds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7. VIII. 90. 03
MORSCHACH
8.VIII.90

Saltwood Hythe Kent July 11th 1890 Monday

f42r

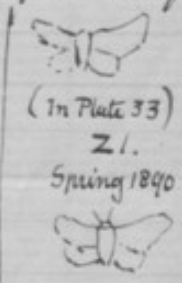
Dear Sir. Your letters of 9th & 8th arrived today & yesterday Thank you much for all particulars & forms & model.

Mr Merrifield counted over all the A M Z's after Plate 8 with me last Friday & has written explanations of their order, & labels, & shown me & noted where the parents are to be found.

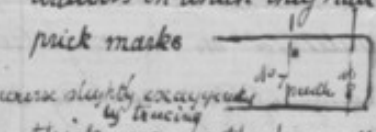
He has classified & arranged all so beautifully, that with the help of your A M Z charts I hope to be able to get on in his absence —

Since seeing him, it occurred to me that the quickest & simplest arrangement wold be, to keep to your outline plan of headings & compartments, which shows so well, what there is to do, & which will require almost no alteration, & to arrange the moths vertically in those compartments in all but those few cases, where there is but one row of 4 or fewer moths

If the vertical way is kept to entirely I should have to cut many of the headings into 3. for families which begin in the midst of a plate


(In Plate 33)
Z 1.
Spring 1890

I shall have to remove the present sets of moths from the drawers in which they have been photographed in order to make the prick marks



of course slightly exaggerated by tracing

this is a tracing round a bit of cork carpet, showing its thickness. so that needles would have to penetrate that to touch the glass-bottomed drawers, if the forms are pricked when in position. I have just pricked the above 2 holes through the thickness of cork carpet onto glass I doubt if a smaller prick than with No 8 would show sufficiently on the negative, reduced to ½ size, it is slightly smaller than the dot of the i in Family in the printed headings

? I suppose the pricks are to be visible on the negatives. I quite understand the need of using my fine needle to prick through the "standard," but suppose the working needle should be larger Is this no 8 too large?

I rather think that this cork carpet would make a good hold for the needles, & that it would be well to try make a 40 mm pricking like your model, sticking the slip of carpet against a slip of glass & a bit of glass along the top to keep the heads of needles at equal height (we have plenty of glass scraps as we cut up our waste negatives into covers for lantern slides) if fixed with paper where the points come out I could see if the needles worked loose My electrical engineering student brother will be coming on Saturday & I can borrow his slide rule or take all from "Standard" at 1 step.

† like your pattern pricker

to make sure of getting the needles as accurately placed as I can (if this answers I could use it through the "working" strip).

The 40 mm space starts from about 7 mm from the left side & end about 6 mm from the right. I suppose it doesn't matter about the moths being placed exactly ‡ way, at 20 mm, I think the faint blue lines don't quite fit.
Or I could prick at 20 mm for the moths at the same time there are plenty of plain lithographed forms.

I think I had better not begin photographing till I can get a succession of fine days, to ward the end of next week at earliest probably the week after, wh will give time for you to send this letter back, perhaps, with comments if you think fit.

And for me to get the fixing adjustments completed, & the numbers (of the Plates) cut out & pasted to headings etc. P.S. I have done the 4 set

I quite hope that I may succeed in getting the whole of each lithographed form, as far as to include the heading, properly placed on the focussing screen & included on the negative. & that there may be no need to consider any of the printing as "waste".

If there is any difficulty about shadows in printing, that can be got over by using larger frames, or some with a shallower rim. I think I can arrange to screw the front of my camera firmly in position, & also that you have provided plenty of money to cover all possible expenses, thank you.

I will get a metal rack to hold the negatives while washing & drying, which will save them from much risk of finger marks, breakage & dust.

& no lines cut off

If I can keep the headings of plates quite visible on the negatives I suppose the plate scratched on negative would not be required.

Or would you like it in any case? Inside row 11 to print visibly?
I am not sure that I could do it neatly enough. I often do to scratch name & date on negative, but not where it has to be shown in printing. Would the above printed figures do, reduced to ‡ size. It hides the prick mark on the full sized form, when horizontal, would the number only do. I could cut these out of an old catalogue & see the pricked bit of "form"

(new & placing succeeding number)
sticking them with a dot of paste & removing with each change of moths.

I can cut out enough letters (A M Z) from spare headings to insert for the 1st 8 plates. but as I must in any case remove the moths to make prick marks through the paper strip — I may as well begin now at Pl 9 as you suggest —
... I have now tried making a working measure strip & have pricked a No 8 needle through the thickness of oak carpet such as the drawers are lined with but apparently forgot to make the 1st prick, so had to replace the strip after having taken it off. ~~so had to replace it~~ & have made a double prick at 2 in consequence. I probably could avoid this in practice, & could make sure before removing the strip, but it would be impossible to make that mistake if I had a pricker as you proposed in your letter of the 8th so perhaps I had better have a try at making it, after hearing from you about the size of the prick hole —

I quite expected you to say that the proofs were not accurate enough & should not at all have liked to do permanent prints from such conspicuously imperfect & inaccurate negatives —

Yours very truly
F Marian Reynolds

In three cases on your A M Z charts females which begin in the middle of a plate, extend into the next plate, & do not quite fill it. shall I head them with "females continued" on the top line (or print one), it will disturb nothing as there are several blank rows after them in each case

not a bit

yes it would

Excellent, if you can get the moths the case

12 Aug. f4a

to make sure of getting the needles as accurately placed as I can. If this answers I could use it through the "working" strip).

not a bit

The 40 mm spaces inserts from about 7 mm from the left side & end about 6 mm from the right. I suppose it doesn't matter about the moths being placed exactly ½ way, at 20 mm, I think the faint blue lines don't quite fit.
Or I could prick at 20 mm for the moths at the same time) there are plenty of plain lithographed forms.

I think I had better not begin photographing till I can get a succession of fine days, & not till toward the end of next week at earliest probably the week after, wh will give time for you to send this letter back, perhaps, with comments if you think fit.

And for me to get the fixing adjustments completed & the numbers (of the Plates) cut out & pasted to headings etc. P.S. I have done the A set.

I quite hope that I may succeed in getting the whole of each photographed form, as far as to include the heading, properly placed on the focussing screen & included on the negative. & that there may be no need to consider any of the printing as "waste."

If there is any difficulty about shadows in printing, that can be got over by using larger frames, or some with a shallower rim. I think I can arrange to screw the front of my camera firmly in position, & also that you have provided plenty of money to cover all possible expenses, thank you.

I will get a metal rack to hold the negatives while washing & drying. which will save them from much risk of finger marks, breakage & dust.

yes I would

I am not sure that I could do it neatly enough. I often do a scratch name & date on negative, but not where it has to show in printing. Would the above printed figures do, reduced to ½ size. Pl hides the prick mark on the full sized form, when horizontal, would the number only do. I could cut these out of an old catalogue.

excellent if you can manage this case

← see the pricked bit of "form"

(from & placing succeeding number)
sticking them with a dot of paste & removing with each change of moths.

I can cut out enough letters (A M Z) from spare headings to insert for the 1st 8 plates. but as I must in any case remove the moths to make prick marks through the paper strip – I may as well begin now at Pl 9 as you suggest.

... I have now tried making a working measure strip & have pricked a № 8 needle through the thickness of oak carpet such as the drawers are lined with. but apparently forgot to make the 1st prick, so had to replace the strip after having taken it off. ~~so had to replace it~~ & have made a double prick at 2 in consequence. I probably could avoid this in practice, & could make sure before removing the strip, but it would be impossible to make that mistake if I had a pricker as you proposed in your letter of the 8th so perhaps I had better have a try at making it, after hearing from you about the size of the prick holes.

I quite expected you to say that the prints were not accurate enough & should not at all have liked to do permanent prints from such conspicuously imperfect & inaccurate negatives.

Yours very truly
H Marian Reynolds

In three cases in your set M Z inserts females which begin in the middle of a plate, extend into the next plate, & do not quite fill it. shall I head them with "females continued" (or points out) on the top line), it will disturb nothing as there are several blank rows after them in each case.

Southover. Wortthing —
f. 5r
Dec 11 1890

Dear Sir

I hope you will kindly excuse me for enclosing a letter which is now rather old as I was not able to complete it as soon as I wished & rewriting would cause more delay — & I am sorry to have been so long as it is —

We have had two splendidly fine days, & I have been able to progress considerably with the printing, having now completed, 2 sets, which are posted tonight, & advanced considerably, with 4 other sets. These I could probably finish (with a good light) in one or two days. It would depend also on how much washing they had, for many inferior prints are now included.

I will not send these other sets yet, as if you should like me to print some more sets it would be better to keep & compare all

12th

finally. I find I have a few good prints towards an 8th set. the 7th is a bad one, consisting of first attempts & rejections from other sets— I could be ready to send off the negatives next wk. or if you like me to finish the printing here I could probably get up to 8 sets by Christmas. finishing the rest in January— If 12 is still the number of sets required? S. a m. A letter just arrived from Mr Mansfield reports that you would like another generation photographed—. Perhaps I had better send off this & write again after hearing from you. I should like to try them here I think but will talk to Mr Mansfield one day next wk. & perhaps I shall have heard from you then, how much time you propose to allow for completion of prints & whether this further moth generation is to be conducted with the rest

Please excuse all these hasty scraps. I think you will find page. 2 to the end quite enough to read of my old letter—

Another fine day & accrual of fresh pupil will enable me to almost complete another set or two to day I hope—

Yours very truly.
H McReynolds—

You will see in my note of accounts that I have probably enough money left to complete the extra negatives required for the 8th generation

f 61

Southover. Worthing
6. Dec. 1890

Dear Sir

You may perhaps wish to hear when I am likely to have finished the sets of prints. I have one more, complete, & another nearly ready, & if weather permits ought to have all finished in 6 or 7 days. But there is more uncertainty about platinum printing than there is with silver as platinum paper is so much more affected by damp. It is in many cases desirable to print in the sun, for slow printing negatives have now to stay out so long that the paper deteriorates from damp.

So I am not altogether aiming at com-

I enclose a memorandum stating particulars of the chief part of the materials & apparatus brought with the £6. with which you provided me. I have not given all details of chemicals. all are not used up, & I have not in all cases started separate bottles of solutions for occasional use, as we have not much space to spare for these intensifying etc photographers. But I think this 5/2 is about right for home mixed made developer etc.

I have not kept account of postage, but have had 30 letters & 2 telegrams from you & from Mr Merrifield on Pedigree matter subjects (I have a good pile about his colour matters too)

The only other expense that occurs to me is a washing trough & rack for holding negatives which it was almost necessary to get to avoid risks with such large numbers of negatives as I had hardly any safe places for drying & washing more than 2 or 3 at a time

And when I came to do the positives I thought

pleting sets in series, but keeping certain dense negatives for a sunny morning — It is unfortunately rather extra difficult to get anything approaching to similarity of tint at this time of year with negatives of such varied density, when sunlight is infrequent & I am not at all satisfied with the prints — they look horribly patchy when spread out panorama fashion, & always print badly. R 28 for 8x. I should have done better to have made a fresh negative from the mother as with R 3

8th Dec. The platinum paper which I have been trying to get for some days has now arrived so I hope to get on with the prints & am very sorry to have been so long — you must be wanting to decide about the rest of the sets, if you at all prefer to secure all needful prints before the plates make further journeys. It is probable that I could undertake to do them all, but it is also probable that you would get them done better by professional workers — If you decide on having the rest done by professionals perhaps I had better send off the 1st & 2nd box of negatives as soon as I have finished with them, in a few days I hope., & I will send two complete sets as soon as possible that you may be more able to judge of the prints I am likely to produce at present. I have nearly a set of very poor looking faint prints, the first I did when the paper suffered from long keeping & inexperience on my part. In fine weather I could do a set in 2 days, but it would hardly safe for me to say that I could do one in 3 just in these present few wks. Though it is quite possible, if we should have a little sun to hasten the slow printing negatives.

I could hardly get on without a vertical fixing tank also, as I had only a ½pl. dish to hold one plate at a time, & these good thickly coated plates, fix slowly - With the help of this tank which held 6. I one day in London managed to make 14 positives before & after, daylight. These tanks were 7/6 each but as I should like to keep them I have not put them down on the list.

The journeys are the most expensive part of all. I think if I were doing it again that it would cost much less to bring the moths over here, & use less expensive plates, most are good, & if I developed as I exposed I could easily retake any plate the negative of which appears defective.

One day, I went over in the afternoon just before Mr Merrifield went abroad, at his request, to go over with him, the lists & arrangements of all the moths; then only

f.7v

just completed - The other days were all spent on arranging & photographing.

		£	s	d		
	Plates.					
1 doz	¼ Isochromatic.		2			
2 "	½ "		7	8		
2 "	½ "		8			
2 "	½ Wratten's ordinary — 3/9		7	6		
	Plates for positives & extra negatives				1 " 5 " 2	
3 doz	½ Wratten ordinary at 3/6		10	6	.	
1 "	½ " " & extra plates 3/9		4	3	.	
					14 " 9	
	Chemicals		5	2	5 2	
	Carpenter for copying stand & platform		5		. .	
	Screws etc		1		. .	
2 pr	Brass stretchers at 1/6 —		3		. .	
	Screws & fittings for stretchers —		2	2	. .	
	Set square		1		. .	
					12 2	
	Printing Materials					
1	6 sheets Ferro-prussiate paper 6d		3			
For proofs	2 " Matt solution " 10d		1	8		
	Toning solution etc			6		
For 1 set	Platinum paper, salts acid, postage		9	6½		
Platinum	Enamelled cloth rubber pads & band		2	9		
(Hot bath	Chemical Thermometer —		1			
					18 " 5½	
	Omitted from price of retouching desk			6		
	Grooved box for positives		2			
					2 · 6	
	Journeys					
18 days	To & from Watkins W. Watkins & Brighton		1	12	1	
	Carriage of apparatus —				6	
					1 " 12 " 7	
	Total	£	5	10	9½	

Received for Photographic expenses in connection with Pedigree Moth &c

2nd July	—	£ 2
11 "	cheque	to be filled in to amount not exceeding £5
25 August	" filled in to	£ 3
26 September		£ 1
Total		£ 6

F.91

Southover. Worthing

17 Feb 91

Dear Mr Galton

I enclose a dark print of 43 & the measurement showing difference between the two sides of the "form" omitted yesterday - As you would like me to decide about the negatives, & as my brother now wants his slide rule - I have compared the vertical pricks with the 20 m divisions on the rule - & as far as I can make out there does not seem to be more enlargement or reduction than perhaps the thickness of the lines of the form (as seen on the print.) In 3 plates the upper left prick prick marks enclose a space just under 20 m m. & in one case the space is

right side was just too large — still it was so little beyond the mark, that I am inclined to think that you would consider the negatives all passable as far as this rough test goes, but I fear that when placed in the retouching frame & measured the whole length on each side, that the error will prove more considerable —

Yours very truly
R Marian Reynolds

PLATE 43 A 1.a SUMMER 1890.

	I	II	III	IV f.10
1				
2				
3				
4				
5				
6		Females		
7				
8				
9				
10				
11				

f.1r

14, Brookside,
Cambridge.

11th. June, 1889.

Dear Sir,

Your kind letter has delighted me: and I am looking forward with great pleasure to the arrival of Mr. Merrifield's instructions.

As you probably wish to know where your moths can be found at any given moment,

I must tell you that I propose to spend a year or so at Plymouth, where letters addressed to me at the Laboratory of the Marine Biological Association, Citadel Hill, will always find me after this week.

Believe me,

Yours very truly

W. F. R. Weldon.

f.25

1, HOE VILLAS.
ELLIOT STREET,
PLYMOUTH.

16th November 1889.

Dear Sir,

I am sorry to be unable to give you as good an account of the moths entrusted to me as that given by Mr. Merrifield.

I had at the beginning a great many cages through to mould. And at the end of the feeding time the covers of the bottles containing the caterpillas were, by an unfortunate accident, removed during my absence: so that a great many larvæ escaped.

I am very sorry, and very much

ashamed that this should have happened.

I have sent the paper to Mr. Merrifield: because I feel that I ought not to let the Experiment run the risk of a repetition of my misfortunes.

Yours very truly

W. F. R. Weldon

about Miss Pridham f.1r

STATION PUTNEY.
TELEGRAPH WIMBLEDON.

FLORYS,
PRINCES ROAD,
WIMBLEDON PARK.

19 Jan/89

Dear Sir Galton

I find that Miss Pridham is the step daughter of a more or less retired Medical man who lives near us. My wife knows her, though I only do so by sight. I always

Maybe her name was the same
as his, Martin. We are not
intimate with them, or I should
have been able to tell you at
once that she is a lady.

Yours truly

D. H. Lawrence

[For Private Circulation.]

PEDIGREE MOTHS.

I. On a proposed series of experiments in breeding Moths, by FRANCIS GALTON, F.R.S.

II. Appendix asking for living specimens of, and information about *Selenia Illustraria* (Purple Thorn) by FREDERIC MERRIFIELD.

I desire to institute a system of experimental breedings, to be continued for several years, with the object of procuring some much-needed Hereditary data.

The information I have thus far succeeded in obtaining and using, refers only to two or three consecutive generations; nevertheless, it has already yielded important results. These I greatly desire to verify and to extend by help of special experiments prolonged for many more generations. It is intended in each case to procure broods through a succession of selected specimens, along three lines of descent from a single pair of individuals, so that there would be three parallel broods in each generation. The particular characteristic that is selected for these experiments must admit of being accurately measured, in other respects the choice is immaterial. For brevity of explanation I will suppose it to be *size*. Then, starting from the brood of the original pair, (1) a few of the largest of either sex would be separated and mated; out of their progeny a few of the largest would again be taken and mated, and so on, for several successive generations. (2) Exactly the same process just described would be gone through, after substituting throughout the words "medium-sized" for "largest." (3) Similarly after substituting the word "smallest" for "largest."

The result will be to obtain a precise measure of the diminution of rate at which a divergence from the average of the race proceeds in successive generations of continually selected animals. The rate during the first few generations is probably the same whatever may be the characteristic observed (whether size or anything else) and whatever may be the kind of animal or plant experimented on. It will depend on the amount of the ancestral divergencies, measured with a special and relative unit ("probable error" as mathematicians call it), that I have often written about and cannot stop now to describe. This unit enables us to treat on equal terms individuals of either sex, or those in separate broods that have been affected by differences of nourishment, &c. I have shewn the rate of divergence to be the same within the limits of statistical error, in the case of (1) weight and size of sweet peas; (2) human stature; (3) human eye-colour. The course of investigation pursued is necessarily technical; it will be found described in —Law of Regression, *Journ. Anthrop. Inst.*, 1885; Family Likeness in Stature *Proc. Royal Soc.*, 1886; Family Likeness in Eye-Colour, *Proc. Royal Soc.*, 1886.

From the data obtained in these inquiries I derived the law of "Regression," which leads to many curious results. One is, that each parent contributes, on the average, one quarter of the total hereditary peculiarities of the child, each grand-parent one-sixteenth, and so on. In other words, that the two parents together contribute one half, the four grand-parents a quarter, the eight great-grand-parents one-eighth, and so on, the whole heritage being thus accounted for. It is, however, highly probable from other considerations, that though this simple formula may be closely true for the parents, and nearly true for the grand-parents, it may become sensibly and increasingly different for remoter progenitors. It is this fact that I want to investigate, because all theory concerning the nature of stability of type, and of much else, must be based upon the facts of Regression, which such experiments as those proposed can alone, so far as I see, be likely to declare in a trustworthy way.

For the purpose of an independent verification of the observed results, I hope, after the sixth generation shall have been reached, to institute another series of experiments in the converse direction, by breeding from mediocre representatives of each of these parallel broods, and again from mediocre representatives of their offspring, and so on continuously until no trace remains of their several temporary ancestral differences.

The most suitable animal or plant would be one that is hardy, quickly breeding, of small size, easily measured and preserved, and bearing broods of about 50 or 100 individuals. Mr. F. Merrifield, of 24, Vernon Terrace, Brighton, suggested, in answer to my inquiries, that English Moths which breed normally twice in the year, and that *Selenia Illustraria* in particular, would be very suitable. He, moreover, most kindly offered to carry on a series of experiments for me. From all I can as yet learn, Mr. Merrifield's suggestion seems to be a peculiarly happy one, and the wing-length seems to be a good subject for measurement. I have accepted his offer gratefully, more especially as he has had considerable experience in breeding this moth in former years. There are, however, many points on which he still desires as much information and assistance as he can obtain from experts. These are explained by himself in the annexed memorandum. Entomologists would help in a good cause if they would reply, so far as they are able, either to him or to myself.

I should add that the details of the whole procedure have been provisionally settled, but it is reasonable to anticipate that the proposed methods will be somewhat modified after a little experience. Then I shall hope to be able to describe them fully and clearly, in trust that others may be induced to co-operate on the same lines. It is important that more than one stock should exist of the same species of Moths having known pedigrees, in order that they may be cross-bred and the evil of too close interbreeding within a single stock be avoided.

FRANCIS GALTON,

42, RUTLAND GATE, LONDON, S.W.

January, 1887.

APPENDIX,

BY FREDERIC MERRIFIELD.

1. *At least Twenty Pupæ* are desired, to breed from next Spring; in default of these, 200 or more *eggs* next Spring. If 100 or more pupæ can now be supplied there will be a gain of one generation, as the first selection can in that case be made next Spring. It is *essential* that the pupæ or eggs should be fair representatives of the insect in its natural wild condition; those which result from interbreeding, or from larvæ fed up under unnatural conditions will be disqualified. The origin or history, therefore, of any which are offered must be accurately stated. Pupæ dug this winter, or eggs from moths caught wild next Spring are preferable. Any information as to where fresh pupæ can now be obtained, or supplying the names and addresses, &c., of persons by whom the obtaining of eggs in the Spring can be *guaranteed*, will be valued. The insect seems diffused over the South of England, and is recorded as plentiful in the New Forest and at Plymouth. A fair price will be paid for pupæ or eggs supplied.

2. *Number of Eggs.*—Entomologists, who have bred *Selenia Illustraria*, will oblige by stating what is the *usual* and what the *least* number that one healthy individual lays; and what, if any, difference there is in this respect between the Spring and the Summer breed of Moths.

3. *Mating, and Laying of fertile Eggs.*—The results of experience as to the best means of rendering certain these ends are desired. Especial attention is called to the following points. *(a)* May each pair which it is desired to mate be kept separate from all other pairs, or should two or more pairs be placed together for mating according to natural individual preferences? The former course is preferable unless it will seriously imperil results. *(b)* What space should be allowed—would muslin bags, of about 6in. by 3in., supported by enclosing in them a small spray of growing birch, be sufficient for one pair?

4. *Preserving the Moths in a Living State.*—The Spring brood of Moths in ordinary seasons emerges from about the beginning of April to the middle of May. All, or nearly all, of a brood have to be preserved alive and vigorous, that the selection of pairs for breeding may be made. It is proposed to attain this end by placing the pupæ, each in a separate chip box (about 1¼ inch diameter, with a black net lid), in a warm room, as soon as the first moth emerges; to move all the moths, as they emerge, in their chip boxes, into a cool room, keeping them in absolute darkness and in a cold and rather moist air by a covering constructed on the evaporating zinc butter-cooler principle. Can any improvement on this plan be suggested? It is believed that the moths thus kept will live in a state of suspended animation for four or five weeks and be vigorous at the end. Is this so? Do they require feeding? It is thought not, as the tongue seems imperfect.

For purposes of accurate measurement, it may be advisable to temporarily stupefy the moths. Actual experience of safe agents for this purpose will be valuable—chloroform or ether vapour, &c., or cold. Will this or allied species survive, in full health, a freezing temperature?

5. *Feeding up the Larvæ.*—it being important to bring up the broods with as little loss of individual lives as may be, of full size and in a healthy condition. It is proposed to start the broods in a cool room, in jam pots with the rims ground level, and covered with pieces of plate glass (laid on an inner covering of muslin held in place by an elastic band, so as to allow of occasional airing by wholly or partially sliding away the glass); and, when the larvæ are a little over half an inch long, to transfer them into ordinary breeding cages kept in a cool and shady place out of doors; these cages constructed with glass tops and ends and cheesecloth sides so as to admit of a thorough draught, but capable of being closed by a light shutter on either side in windy weather, &c.

What cubical space is necessary for health? It is considered that 15in. by 13in. by 6in.—1170 cubic inches—would be enough for from 120 to 150 larvæ; this would allow from 8 to 10 cubic inches each.

It is believed that Selenia Illustaria is not prone to dwindle in captivity, but any suggestions for obviating all risk of such a result will be acceptable; as to ventilation, keeping the food-plant healthy, and general treatment. Is not occasional sprinkling with a fine spray of soft water desirable? Is change of food-plant, which may be sometimes convenient, injurious to this or allied species? Does it thrive better on one of its ordinary food-plants (birch, oak, ash, sallow, hawthorn, &c.) than another? Any experience as to feeding on growing trees, protected by (muslin?) bags, will be welcome.

6. *Preserving Pupæ Alive and Well.*—It is proposed to keep them out of doors but sheltered, and to lay them, in their slight cocoons, on sandy peat, well baked to kill enemies, and kept slightly moist by infiltration and not by surface watering.

Any information or suggestions on the points above indicated, or any others thought material, especially from those who have had practical experience in successfully breeding Moths such as Selenia Illustraria for several successive generations, will be gratefully acknowledged.

F. MERRIFIELD,

24, VERNON TERRACE, BRIGHTON.

[For Private Circulation.]

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I desire to institute a system of experimental breedings, to be continued for several years, with the object of procuring some much-needed Hereditary data.

The information I have thus far succeeded in obtaining and using, refers only to two or three consecutive generations; nevertheless, it has already yielded important results. These I greatly desire to verify and to extend by help of special experiments prolonged for many more generations. It is intended in each case to procure broods through a succession of selected specimens, along three lines of descent from a single pair of individuals, so that there would be three parallel broods in each generation. The particular characteristic that is selected for these experiments must admit of being accurately measured, in other respects the choice is immaterial. For brevity of explanation I will suppose it to be *size*. Then, starting from the brood of the original pair, (1) a few of the largest of either sex would be separated and mated; out of their progeny a few of the largest would again be taken and mated, and so on, for several successive generations. (2) Exactly the same process just described would be gone through, after substituting throughout the words "medium-sized" for "largest." (3) Similarly after substituting the word "smallest" for "largest."

The result will be to obtain a precise measure of the diminution of rate at which a divergence from the average of the race proceeds in successive generations of continually selected animals. The rate during the first few generations is probably the same whatever may be the characteristic observed (whether size or anything else) and whatever may be the kind of animal or plant experimented on. It will depend on the amount of the ancestral divergencies, measured with a special and relative unit ("probable error" as mathematicians call it), that I have often written about and cannot stop now to describe. This unit enables us to treat on equal terms individuals of either sex, or those in separate broods that have been affected by differences of nourishment, &c. I have shewn the rate of divergence to be the same within the limits of statistical error, in the case of (1) weight and size of sweet peas; (2) human stature; (3) human eye-colour. The course of investigation pursued is necessarily technical; it will be found described in —Law of Regression, *Journ. Anthrop. Inst.*, 1885; Family Likeness in Stature *Proc. Royal Soc.*, 1886; Family Likeness in Eye-Colour, *Proc. Royal Soc.*, 1886.

From the data obtained in these inquiries I derived the law of "Regression," which leads to many curious results. One is, that each parent contributes, on the average, one quarter of the total hereditary peculiarities of the child, each grand-parent one-sixteenth, and so on. In other words, that the two parents together contribute one half, the four grand-parents a quarter, the eight great-grand-parents one-eighth, and so on, the whole heritage being thus accounted for. It is, however, highly probable from other considerations, that though this simple formula may be closely true for the parents, and nearly true for the grand-parents, it may become sensibly and increasingly different for remoter progenitors. It is this fact that I want to investigate, because all theory concerning the nature of stability of type, and of much else, must be based upon the facts of Regression, which such experiments as those proposed can alone, so far as I see, be likely to declare in a trustworthy way.

For the purpose of an independent verification of the observed results, I hope, after the sixth generation shall have been reached, to institute another series of experiments in the converse direction, by breeding from mediocre representatives of each of these parallel broods, and again from mediocre representatives of their offspring, and so on continuously until no trace remains of their several temporary ancestral differences.

The most suitable animal or plant would be one that is hardy, quickly breeding, of small size, easily measured and preserved, and bearing broods of about 50 or 100 individuals. Mr. F. Merrifield, of 24, Vernon Terrace, Brighton, suggested, in answer to my inquiries, that English Moths which breed normally twice in the year, and that *Selenia Illustraria* in particular, would be very suitable. He, moreover, most kindly offered to carry on a series of experiments for me. From all I can as yet learn, Mr. Merrifield's suggestion seems to be a peculiarly happy one, and the wing-length seems to be a good subject for measurement. I have accepted his offer gratefully, more especially as he has had considerable experience in breeding this moth in former years. There are, however, many points on which he still desires as much information and assistance as he can obtain from experts. These are explained by himself in the annexed memorandum. Entomologists would help in a good cause if they would reply, so far as they are able, either to him or to myself.

I should add that the details of the whole procedure have been provisionally settled, but it is reasonable to anticipate that the proposed methods will be somewhat modified after a little experience. Then I shall hope to be able to describe them fully and clearly, in trust that others may be induced to co-operate on the same lines. It is important that more than one stock should exist of the same species of Moths having known pedigrees, in order that they may be cross-bred and the evil of too close interbreeding within a single stock be avoided.

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January, 1887.

APPENDIX,

BY FREDERIC MERRIFIELD.

1. *At least Twenty Pupæ* are desired, to breed from next Spring; in default of these, 200 or more *eggs* next Spring. If 100 or more pupæ can now be supplied there will be a gain of one generation, as the first selection can in that case be made next Spring. It is *essential* that the pupæ or eggs should be fair representatives of the insect in its natural wild condition; those which result from interbreeding, or from larvæ fed up under unnatural conditions will be disqualified. The origin or history, therefore, of any which are offered must be accurately stated. Pupæ dug this winter, or eggs from moths caught wild next Spring are preferable. Any information as to where fresh pupæ can now be obtained, or supplying the names and addresses, &c., of persons by whom the obtaining of eggs in the Spring can be *guaranteed*, will be valued. The insect seems diffused over the South of England, and is recorded as plentiful in the New Forest and at Plymouth. A fair price will be paid for pupæ or eggs supplied.

2. *Number of Eggs.*—Entomologists, who have bred *Selenia Illustraria*, will oblige by stating what is the *usual* and what the *least* number that one healthy individual lays; and what, if any, difference there is in this respect between the Spring and the Summer breed of Moths.

3. *Mating, and Laying of fertile Eggs.*—The results of experience as to the best means of rendering certain these ends are desired. Especial attention is called to the following points. *(a)* May each pair which it is desired to mate be kept separate from all other pairs, or should two or more pairs be placed together for mating according to natural individual preferences? The former course is preferable unless it will seriously imperil results. *(b)* What space should be allowed—would muslin bags, of about 6in. by 3in., supported by enclosing in them a small spray of growing birch, be sufficient for one pair?

4. *Preserving the Moths in a Living State.*—The Spring brood of Moths in ordinary seasons emerges from about the beginning of April to the middle of May. All, or nearly all, of a brood have to be preserved alive and vigorous, that the selection of pairs for breeding may be made. It is proposed to attain this end by placing the pupæ, each in a separate chip box (about 1¾ inch diameter, with a black net lid), in a warm room, as soon as the first moth emerges; to move all the moths, as they emerge, in their chip boxes, into a cool room, keeping them in absolute darkness and in a cold and rather moist air by a covering constructed on the evaporating zinc butter-cooler principle. Can any improvement on this plan be suggested? It is believed that the moths thus kept will live in a state of suspended animation for four or five weeks and be vigorous at the end. Is this so? Do they require feeding? It is thought not, as the tongue seems imperfect.

For purposes of accurate measurement, it may be advisable to temporarily stupefy the moths. Actual experience of safe agents for this purpose will be valuable—chloroform or ether vapour, &c., or cold. Will this or allied species survive, in full health, a freezing temperature?

5. *Feeding up the Larvæ,*—it being important to bring up the broods with as little loss of individual lives as may be, of full size and in a healthy condition. It is proposed to start the broods in a cool room, in jam pots with the rims ground level, and covered with pieces of plate glass (laid on an inner covering of muslin held in place by an elastic band, so as to allow of occasional airing by wholly or partially sliding away the glass); and, when the larvæ are a little over half an inch long, to transfer them into ordinary breeding cages kept in a cool and shady place out of doors; these cages constructed with glass tops and ends and cheesecloth sides so as to admit of a thorough draught, but capable of being closed by a light shutter on either side in windy weather, &c.

What cubical space is necessary for health? It is considered that 15in. by 13in. by 6in.—1170 cubic inches—would be enough for from 120 to 150 larvæ; this would allow from 8 to 10 cubic inches each.

It is believed that Selenia Illustaria is not prone to dwindle in captivity, but any suggestions for obviating all risk of such a result will be acceptable; as to ventilation, keeping the food-plant healthy, and general treatment. Is not occasional sprinkling with a fine spray of soft water desirable? Is change of food-plant, which may be sometimes convenient, injurious to this or allied species? Does it thrive better on one of its ordinary food-plants (birch, oak, ash, sallow, hawthorn, &c.) than another? Any experience as to feeding on growing trees, protected by (muslin?) bags, will be welcome.

6. *Preserving Pupæ Alive and Well.*—It is proposed to keep them out of doors but sheltered, and to lay them, in their slight cocoons, on sandy peat, well baked to kill enemies, and kept slightly moist by infiltration and not by surface watering.

Any information or suggestions on the points above indicated, or any others thought material, especially from those who have had practical experience in successfully breeding Moths such as Selenia Illustraria for several successive generations, will be gratefully acknowledged.

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